Vol. 12, No. 20
October 31, 1987

Energy Research Abstracts

Abstracts 40320-42912

Office of Scientific & Technical Information
UNITED STATES DEPARTMENT OF ENERGY

CURRENT INFORMATION ON ENERGY

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The publications described below and access to ITIS/OARS are available to Department of Energy and contractor components from the Office of Scientific and Technical Information, U. S. Department of Energy, P. O. Box 62, Oak Ridge, TN 37831/Telephone (615) 576-1301; FTS 626-1301.

PUBLICATIONS OF THE OFFICE OF SCIENTIFIC AND TECHNICAL INFORMATION

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A comprehensive semimonthly abstract journal devoted to all areas of energy-related information produced by the Department of Energy, other U. S. government organizations, and foreign governments. *ERA* is available from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The annual subscription price for the 24 issues is $146.00 for domestic (North America) subscribers or $182.50 for foreign (outside North America) subscribers. A single issue is $14.00 or $17.50, respectively.

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DOE is prepared to grant exclusive or nonexclusive, revocable licenses under DOE-owned U. S. patents and patent applications; this semiannual publication provides abstracting and indexing coverage of this literature. *PAL* is available as PB87-946800 from the National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161 on a standing order basis through an NTIS Deposit Account. To establish an NTIS account, send the minimum $25.00 deposit to NTIS, Attn: Customer Accounts. A single issue is $12.00 for domestic (North America) and $24.00 for foreign (outside North America).

Energy Meetings (EM)

A monthly listing of conferences, symposia, workshops, etc., pertaining to DOE's programmatic interests. *EM* is available on subscription (use PB87-901500) from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161. The annual subscription price is $70.00 for domestic subscribers and $140.00 for subscribers outside the North American continent; a single issue is $8.00 and $16.00, respectively.

The following semimonthly bulletins are also available from the National Technical Information Service. The annual subscription rate for one volume (calendar) year (24 issues; no indexes) is $80.00 for domestic (North America) and $160.00 for foreign (outside North America) subscribers; use the identifying order number (PB- No.) when subscribing.

Acid Precipitation (APC)–**PB87-901000.** Acid precipitation, including effects and possible control measures.

Buildings Energy Technology (BET)–**PB87-900700.** Technology required for energy conservation in buildings of all types.

Coal-Based Synfuels (CBS)–**PB87-901400.** Conversion of coal into gaseous or liquid fuels.

Coal Combustion and Utilization (CCU)–**PB87-914400.** Coal combustion, including fluidized bed combustion, and direct utilization of coal for power generation, fuel cells, and MHD generators.

Coal Preparation and Pollution Control (CPC)–**PB87-900800.** Coal preparation and cleaning and reducing pollution from its direct combustion.

Direct Energy Conversion (DEC)–**PB87-946600.** Photovoltaics, magnetohydrodynamics, electrohydrodynamics, thermoelectrics, thermionics, and fuel cells.

Energy from Biomass (EFB)–**PB87-900600.** Biomass production, conversion, and utilization for energy.

Geothermal Energy Technology (GET)–**PB87-914700.** Exploration, development, and utilization of geothermal resources.

Heavy-Ion Reactions (HIR)–**PB87-900500.** Heavy-ion (A > 4) reactions.

Laser Research (LAR)–**PB87-901100.** Laser research and development, excluding applications.

Nuclear Fuel Cycle (NFC)–**PB87-913400.** Both front and back ends of the nuclear fuel cycle.

Nuclear Reactor Safety (NRS)–**PB87-913500.** Accident analysis, safety systems, radiation protection, decommissioning and dismantling, and security measures.

Radioactive Waste Management (RWM)–**PB87-902900.** Management aspects of transport and storage, waste processing, waste disposal, waste storage, radioactive effluents, and shipping containers.

Solar Thermal Energy Technology (STT)–**PB87-901200.** Research and development of efficient and reliable solar thermal conversion systems.

Transportation Energy Research (TER)–**PB87-900900.** Energy-efficient advanced automotive propulsion systems and transportation energy conservation.

Unconventional Petroleum (UCP)–**PB87-901300.** Secondary and tertiary recovery of petroleum and oil shales and tar sands.

INTERNATIONAL ENERGY PUBLICATIONS

The Office of Scientific and Technical Information (OSTI) cooperates in the publication of international abstract journals with the following: (1) International Atomic Energy Agency, International Nuclear Information System, Vienna, Austria, for *Atomindex;* (2) International Energy Agency, Biomass Conversion Technical Information Service, Dublin, Ireland, for *Biomass Abstracts;* and (3) International Energy Agency, IEA Coal Research, London, England, for *Coal Abstracts.* In each case, the cognizant foreign agency provides the non-U. S. information to OSTI for inclusion in the Energy Data Base; in turn, OSTI provides the U. S. information for input into the respective journal.

Atomindex

A semimonthly abstract journal providing worldwide coverage of information on nuclear science and technology. *Atomindex* is available by subscription from Bernan Associates—UNIPUB, 10033-F King Highway, Lanham, MD 20706. The cost of an annual subscription, 24 semimonthly issues and semiannual and annual cumulative indexes, is $355.

Biomass Abstracts

A bimonthly abstract journal with comprehensive coverage of information on the conversion of biomass to energy. *Biomass Abstracts* is available free to DOE components and contractors from OSTI. Non-DOE organizations may obtain *Biomass Abstracts* from Biomass Conversion Technical Information Service, Institute for Industrial Research and Standards, Ballymun Road, Dublin 9, Ireland, for 60 IR pounds per year for participating countries and 90 IR pounds per year for nonparticipating countries. Make checks payable to the Institute.

Coal Abstracts

A monthly abstract journal providing comprehensive worldwide coverage of information in the field of coal science and technology. *Coal Abstracts* is available to DOE components and contractors from OSTI. Non-DOE organizations may obtain *Coal Abstracts* from IEA Coal Research, Technical Information Service, 14-15 Lower Grosvenor Place, London SW1W 0EX, England, for 110 pounds sterling per year.

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energinfo ERA
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Vol. 12, No. 20
ISSN: 0160-3604
CODEN: ERABD
October 31, 1987

ENERGY RESEARCH ABSTRACTS

ABOUT THE OFFICE OF SCIENTIFIC AND TECHNICAL INFORMATION

The Office of Scientific and Technical Information (OSTI) in Oak Ridge, Tennessee, has been the national center for scientific and technical information for the Department of Energy (DOE) and its predecessor agencies since 1946. In developing and managing DOE's technical information program, OSTI places under bibliographic control not only DOE-originated information but also worldwide literature on scientific and technical advances in the energy field and announces the source and availability of this information. Although the literature of science is emphasized, coverage extends to DOE programmatic, socioeconomic, environmental, legislative/regulatory, energy analysis, and policy-related areas. To accomplish the mission of furnishing centralized support for Departmental elements in managing their scientific and technical information, OSTI builds and maintains computerized data bases and disseminates information via computerized retrieval systems and announcement publications such as abstract journals, bibliographies, and bulletins. Direct access to OSTI's Energy Data Base (EDB) and Nuclear Science Abstracts Data Base (NSA) is available to the U. S. scientific community through commercial on-line retrieval systems. Access to these data bases from outside the United States is available only through formal exchange agreements. The current-year EDB records, DOE Research-In-Progress, and various other specialized DOE data bases are available to DOE offices and contractors and other government agencies through the OSTI Automated Retrieval System (OARS), which is a major component of the Integrated Technical Information System (ITIS). In addition to providing access to the OSTI on-line systems, ITIS serves as a gateway to other government and commercial systems and provides information merging for customized information products. The Office of Scientific and Technical Information has developed systems to record and communicate energy-related research-in-progress information, to track research report deliverables from DOE contractors, to test and make available DOE-funded computer software programs with scientific and management applications, and to produce special publications in support of DOE program offices. To manage DOE's technical information resources effectively, OSTI's program is one of continual development and evaluation of new information products, systems, and technologies.

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Energy Research Abstracts (ERA) provides abstracting and indexing coverage of all scientific and technical reports, journal articles, conference papers and proceedings, books, patents, theses, and monographs originated by the U. S. Department of Energy, its laboratories, energy centers and contractors. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations. The user should remain aware that *ERA* coverage of non-report literature is limited to that generated by Department of Energy activity.

ERA is comprehensive in its subject scope, encompassing the DOE's research, development, demonstration, and technological programs resulting from its broad charter for energy sources, supplies, safety, environmental impacts, and regulation.

ERA is available on an exchange basis to universities, research institutions, industrial firms, and publishers of scientific information. Inquiries should be directed to the Office of Scientific and Technical Information, P. O. Box 62, Oak Ridge, TN 37831.

ERA is available to the public on a subscription basis from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The subscription rate for the 24 semimonthly issues is $146.00 for domestic subscribers and $182.50 for foreign subscribers. A single issue costs $14.00 (domestic) or $17.50 (foreign). The cumulative indexes will be available in printed form from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The GPO Stock Number is 061-000-00697-4 and the price is $142.00 for the Volume 11 indexes. The cumulative indexes are also available in microfiche form from the National Technical Information Service, U. S. Department of Commerce, Springfield, VA 22161.

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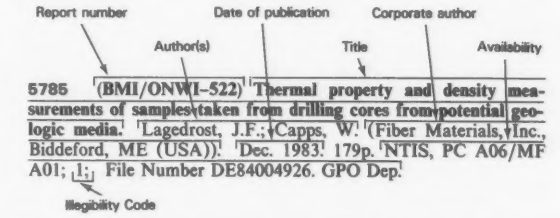
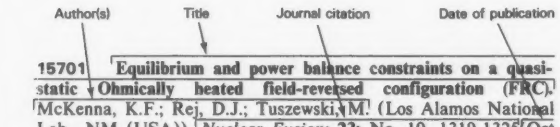
ABSTRACTS IN *ENERGY RESEARCH ABSTRACTS*

The principal elements of abstract entries for a typical research and development report and a typical technical journal article are illustrated below.


Report number
Date of publication
Corporate author
Author(s)
Title
Availability
5785 (BMI/ONWI-522) Thermal property and density measurements of samples taken from drilling cores from potential geologic media. Lagedrost, J.F.; Capps, W. (Fiber Materials, Inc., Biddeford, ME (USA)). Dec. 1983. 179p. NTIS, PC A06/MF A01; 1; File Number DE84004926. GPO Dep.
Illegibility Code

Abstract

Density, steady-state conductivity, enthalpy, specific heat, heat capacity, thermal diffusivity and linear thermal expansion were measured on 59 materials from core drill samples of several geologic media, including rock salt, basalt, and other associated rocks from 7 potential sites for nuclear waste isolation. The measurements were conducted from or near to room temperature up to 500°C, or to lower temperatures if limited by specimen cracking or fracturing. Ample documentation establishes the reliability of the property measurement methods and the accuracy of the results.


Author(s)
Title
Journal citation
Date of publication
15701 Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC). McKenna, K.F.; Rej, D.J.; Tuszewski, M. (Los Alamos National Lab., NM (USA)). Nuclear Fusion; 23: No. 10, 1319-1325 (Oct 1983).

Abstract

Zero-dimensional power balance calculations are performed for a quasi-static, purely Ohmically heated field-reversed configuration. Without compression, the constraint imposed by radial pressure balance limits the power input. Estimates of the energy loss from impurity line radiation as well as from classical and anomalous transport are given. Effects of cold puff gas injection are also investigated.

INDEXES TO *ENERGY RESEARCH ABSTRACTS*

Five indexes are provided for approaching the contents of each issue of *Energy Research Abstracts (ERA)*. Each index is preceded by an introduction that details the organization of the index and the principles by which it was compiled. The reader is referred to these introductions for information not found in the index examples that follow.

• Corporate Author Index

Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

5785 (BMI/ONWI-522) Thermal property and density measurements of samples taken from drilling cores from potential geologic media. Lagedrost, J.F.; Capps, W. **(Fiber Materials, Inc., Biddeford, ME (USA)).** Dec. 1983. 179p. NTIS File Number DE84004926. GPO Dep.

is indexed as:

Fiber Materials, Inc., Biddeford, ME (USA)

• Personal Author Index

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

Capps, W., *See* Lagedrost, J. F.
Lagedrost, J.F., Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
McKenna, K.F., Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9:15701 (J;US)
Rej, D.J., *See* McKenna, K.F.
Tuszewski, M., *See* McKenna, K.F.

• Subject Index

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

SALT DEPOSITS
Density
Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
REVERSED-FIELD PINCH
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Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9: 15701 (J;AT)

• Contract Number Index

DOE technical report literature is indexed using contract numbers. This index contains the contract number with corresponding abstract and report numbers.

AC06-76RL01830	**Fiber Materials, Inc., Biddeford, ME (USA)**	
	9:5785	BMI/ONWI-522

• Report Number Index

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. Patents and conference papers are indexed here as a matter of convenience. When a report is supplied under a File Number, that number is included in the availability statement. A file number–report number correlation is included for convenience.

BMI/ONWI-522	9:5785	NTIS, PC A09/MF A01. File Number DE84004926, Distribution Category MN-70

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CEA Centre d'Etudes de Saclay
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National Institutes of Health
National Library of Medicine
Bethesda, MD

NOVA Information Services Company
Commack, NY

Communication concerning the editorial policy and content of *Energy Research Abstracts* should be addressed to the Editor, *Energy Research Abstracts,* Office of Scientific and Technical Information, P. O. Box 62, Oak Ridge, TN 37831.

SUBJECT CONTENTS (NUMERICAL LISTING)

Six-digit subject category numbers are used in the storage, retrieval, and manipulation of bibliographic information entered into DOE's computerized bibliographic information system. The six-digit category numbers are utilized as if they were three pairs of two-digit numbers, the first two pairs being used to arrange the abstract content of *Energy Research Abstracts*. The following listing includes the totality of the 40 first-level and 289 second-level subject categories used. Because each issue of *ERA* announces only those documents becoming available during a semimonthly period, some subject categories may not be represented in every issue. The complete subject category scheme with scope definitions and limitations is available as DOE/TIC-4584-R6 from NTIS for $9.50.

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REFER ALSO TO CITATION(S) 40396

40320 (DOE/PC/62690—T7) Evaluation of the effect of coal cleaning on fugitive elements: Phase 4, Identification of mineral forms in coal: Final report for the period May 1983 to December 1986. Streeter, R.C. (BCR National Lab., Monroeville, PA (USA)). Dec 1986. Contract AC22-83PC62690. 49p. (BCR-L—1551). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87008697.

This report describes the final phase of a program, activated in 1977, to study the removal of trace elements from coal during cleaning by both controlled laboratory procedures and in commercial coal preparation plants. The Phase IV studies, discussed herein, were originally intended to focus on the mineral constituents in the coal ashes and their relative amounts with respect to known major and trace element concentrations. However, because of changing priorities, the scope of work was redirected in mid-1984 to the characterization of major elements, trace elements, and mineral forms in ultra-cleaned coals from several advanced coal cleaning processes under development. These included the Otisca T, TRW Gravimelt, and LICADO (Liquid Carbon Dioxide) processes. Data are presented for major elements (Si, Al, Fe, Ca, Mg, Ti, P, Na, and K) and trace elements (As, B, Be, Cd, Co, Cu, Mn, Ni, Pb, Sb, Sr, V, and Zn) in feed and product coals from the three processes cited above. The data are evaluated in terms of reduction or enrichment of the ash elemental constituents during coal cleaning, as well as implications for gas turbine slurry fuel applications. Mineral constituents in most of the ultra-clean coal feed and product fractions were identified using X-ray diffraction techniques, and reductions in certain mineral components during coal cleaning were apparent. A limited amount of data was obtained on changes in mineral constituents during physical separations of Illinois No. 6 coal fines (minus 30 mesh). A novel method for the direct determination of certain volatile trace elements (e.g., As, Hg, Se, and Sb) in milligram-quantities of whole coal showed sufficient potential to warrant further investigation. 7 refs., 5 figs., 16 tabs.

40321 (DOE/PC/81202—T1) Development of a technique for rapid efficiency determination of coal cleaning devices: Final report. Ayat, G. (Kentucky Univ., Lexington (USA). Dept. of Mining Engineering). Mar 1987. Contract AC22-85PC81202. 73p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87009864.

In this work a novel technique which uses tagged particles to generate partition data is presented. Individually prepared tagged particles are added to the feed and detected in the product or refuse ports of specific gravity-based processes. Providing that a computer can interpret the output of a detection device tracing particles of predetermined physical properties as they pass through the coal processing equipment plant, and that the particles' behavior is similar to that of coal, sufficient partition data can be provided for computer analyses and control of processing efficiency. The objectives of this work were the following: to develop a method to manufacture synthetic particles of different specific gravities; to develop a method of detecting the tagged coal particles and/or synthetic particles in the output streams from various coal cleaning equipment; to interpret the information obtained in order to rapidly evaluate the performance of the equipment; and to test and optimize the method in laboratory-scale equipment. The overall aim of the project was to develop and test an on-line detection and analysis technique for generating equipment performance information on processes based on specific gravity differences. A manufacturing technique was developed by which synthetic magnetic particles were produced that could closely resemble coal particles in density-separating coal preparation equipment. Under the current effort, the development and testing of a detection system capable of detecting the synthetic particles in the output streams from various coal cleaning equipment have been completed. 16 refs., 23 figs., 27 tabs.

40322 (DOE/PC/90518—T1) Aerated and vibrated chute feeders for particulate materials: Quarterly technical report for the period 3/1/87 to 5/31/87. Jackson, R. (Princeton Univ., NJ (USA). Dept. of Chemical Engineering). 1987. Contract FG22-86PC90518. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011267.

Our study of the flow of particulate materials in inclined chutes under the influence of aeration and vibration has thus far led to a formulation of the equations of motion, boundary conditions and a constitutive theory that describes the system. In this report, we derive the boundary condition that suitably accounts for the energy production due to vibration of the base plate of the chute. The governing equations that describe the motion of particulates with aeration have been solved, and we compare these results with what was obtained earlier, for the unaerated chute. 7 refs.

0104 Processing

REFER ALSO TO CITATION(S) 40358, 40359, 40405, 41480, 42176

40323 (CONF-8705103—1) Fiber-reinforced composite hot-gas filters. Stinton, D.P.; Lowden, R.A.; Chang, R. (Oak Ridge National Lab., TN (USA); Acurex Corp., Mountain View, CA (USA)). May 1987. Contract AC05-84OR21400. 13p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87012257.

From Fossil energy materials program conference; Oak Ridge, TN, USA (19 May 1987).

A chemical vapor deposition process was developed for the fabrication of high-temperature particulate filters. Fibrous materials such as Nicalon (SiC) felt and aluminosilicate papers were used as the filter material. Preliminary evaluation of filter specimens fabricated from Nicalon revealed extremely encouraging results. Cleanable filters with collection efficiencies of >99.9% were recorded for both PFBC flyash and gasifier char. 5 refs., 6 figs., 3 tabs.

40324 (DOE/FE/05081—2198) Assesement of KRW PDU data acquisition and analysis: Topical report. Froehlich, R.E. (Foster Wheeler Synfuels Corp., Livingston, NJ (USA)). Mar 1986. Contract AC21-82FE05081. 284p. NTIS, PC A13; 3; GPO Dep. File Number DE87001010.

Foster Wheeler monitors the KRW PDU operation at Madison, Pennsylvania, for US DOE. In order to analyze PDU results, Foster Wheeler provides independent heat and material balances based on input from KRW's DIS data reports. The Foster Wheeler balances have continually indicated significant discrepancies in both the closure of elemental balances, especially hydrogen, and the heat balance. In addition, apparent forcing of oxygen and hydrogen balances is in evidence in some of KRW's latest reports. In response to the Operating Committee's directive, Foster Wheeler reviewed the methodology currently employed by KRW in reducing the data logs and periodic stream analysis to the final steady state values and balances reported in the DIS reports. In general Foster Wheeler found KRW's procedures to be satisfactory although several areas for correction and improvement were noted. Major Foster Wheeler recommendations include provision for: improvement in coal analysis accuracy by increased sampling and selective discarding of ques-

tionable data; resolution of the problems of missing hydrogen atoms; improvement in product gas flow rate measurement by use of a vortex shedding flowmeter as a back-up product gas flow rate indicator; and improvement in KRW's heat and material balance format. 18 figs., 24 tabs.

40325 **(DOE/FE/60177—2392) Physical and numerical modeling results for controlling groundwater contaminants following shutdown of underground coal gasification processes.** Boysen, J.E.; Mones, C.G.; Glaser, R.R.; Sullivan, S. (Western Research Inst., Laramie, WY (USA)). Mar 1987. Contract FC21-83FE60177. 63p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87013750.

Groundwater contamination has resulted from some of in-situ gasification field tests, and concern over groundwater contamination may hamper commercialization. When UCG recovery operations are terminated, energy remains stored as heat in the adjacent masses of rock and coal ash, and this energy is transferred into the coal seam. Coal continues to pyrolyze as a result of the transferred energy; the products of this coal pyrolysis are a source of groundwater contamination resulting from UCG. A laboratory simulator was developed, and six simulations of UCG postburn coal pyrolysis have been completed. The simulations show that the products of coal pyrolysis are the source of most contaminants associated with UCG operations. Injection of water directly into the UCG cavity can limit postburn coal pyrolysis and reduce the production of contaminants by cooling the masses of rubble and coal ash in the cavity. Water flow through the coal towards the cavity also limits postburn pyrolysis and subsequent contaminant generation; however, steam produced in the heated portions of the coal limits the rate of water flow. Simulation results indicate that UCG field tests should be operated so that the flow of pyrolysis liquids and gases into the formation is prevented and that the natural influx of water into the cavity is allowed. This can be accomplished by minimizing gas leakage to the formation during gasification, venting the cavity after the gasification process is complete, and maintaining low postburn cavity pressures. 11 refs., 17 figs., 17 tabs.

40326 **(DOE/FE/60177—2393) Preliminary investigation of the applicability of underground coal gasification technology for the production of oil from oil shale deposits and residual oil fields.** Trudell, L.G. (Western Research Inst., Laramie, WY (USA)). Jul 1986. Contract FC21-83FE60177. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013448.

A preliminary investigation was conducted to find fossil fuel resources, other than tar sands and heavy oil deposits, that are suitably associated with coal for potential application of underground coal gasification (UCG) technology to provide heat for production of liquid hydrocarbons. Preliminary evaluations of UCG applications for in situ retorting of oil shale and for thermal enhanced oil recovery (EOR) from abandoned oil fields indicate large areas where deposits may be suitably associated. Major resources of Devonian-Mississippian black shales and Carboniferous coal occur in the same regions in the Appalachian Basin, Michigan Basin, Eastern Interior Basin (Illinois Basin), and possibly in eastern Oklahoma. Possibilities for UCG applications to Green River oil shales are limited to a few localities on the flanks of the Rock Springs uplift and Wamsutter arch in Wyoming and on the west edge of the Piceance Basin in Colorado. Because conventional primary and secondary oil recovery processes leave 30% to 60% of the oil in the ground, all oil fields that are suitable for thermal EOR processes and are close enough to coal deposits are potential candidates for use of UCG combustible gas and sensible heat. Such relationships are likely to occur in any of the major coal-bearing regions of the eastern United States and in many of the sedimentary basins of the Rocky Mountain coal province. Oil fields and lignite deposits may occur close together in the Gulf Coastal Plains and northern Great Plains. 19 refs., 2 figs.

40327 **(DOE/MC/21004—2241) Expansion of high-temperature, high-pressure data set for coal gasification: Eight quarterly report for the period June 28, 1986-Sept. 28, 1986.** Solomon, P.R.; Serio, M.A.; Hamblen, D.G.; Heninger, S.G.; Kroo, E. (Advanced Fuel Research, Inc., East Hartford, CT (USA)). 1987. Contract AC21-84MC21004. 34p. NTIS, PC A03/MF A01; GPO Dep. File Number DE87003825.

Construction of the steam pretreatment and coal pyrolysis reactors for experiments with the UCC coal was nearly completed. Two of the pyrolysis experiments done as part of the pyrolysis matrix were repeated in order to verify previous data. The more recent trials were done after slowing down the gas flow to ensure that the particles had a residence time of 0.070 s at the final temperature. These results were more in accordance with other experiments done at the same temperature in the high pressure reactor. Several other experiments were done which were designed to overlap with the METC AGC conditions. The direct comparisons of our data with METC data under the same nominal conditions indicated that the METC data was taken under more severe conditions. It is believed that the use of gas preheated 200-500°F above the nominal reaction temperature in the METC experiments is primarily responsible for the discrepancy. Several (nineteen) CO_2 gasification experiments were done in the high pressure reactor. Some of these were repeat experiments which indicated that reproducibility was good for major product yields (char, tar, gas) and fair for the individual gas species. There is a problem in the FT-IR gas analyses of interference from the large amounts of CO_2 on yields of other gases. We are currently checking gas yield measurements by FT-IR with those from gas chromatography (GC). The characterization experiments for the set of 32 chars discussed in the last quarterly were essentially completed. These included analysis of C,H,N, and ash at a commercial lab, in-house characterization with a TGA for reactivity, FT-IR for functional groups, x-ray for minerals, including sulfur, and Scanning Electron Microscope (SEM) for char structure. 18 refs., 6 figs., 3 tabs.

40328 **(DOE/MC/21225—2239) Wet carbonization of lump-size low-rank coals by a novel non-slurry approach: Progress report for the period February-April 1986.** Lau, F.S.; Roberts, M.J.; Srivastava, V.J.; Mensinger, M.C.; Janulis, J.A.; Rue, D.M.; Henry, M.P. (Institute of Gas Technology, Chicago, IL (USA)). Oct 1986. Contract AC21-84MC21225. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003824.

Construction of the process research unit (PRU) was completed. Installation of the high-pressure boiler for the PRU was essentially completed, except for a few pieces of equipment. During boiler shake down tests, steam condensation shorted out the level probes causing the boiler to shut down. Several methods of remedying the problem were being investigated. During pressure testing of the PRU, several leaks were found. After they were repaired, the PRU was pressure tested successfully to over 2000 psig. Both the feed and discharge conveyors were calibrated with lump-size North Dakota Indianhead lignite. Calibration of instruments and testing of controls were initiated. The results of thermophilic batch anaerobic biogasification potential assays with filtered wet-carbonization product water showed a methane yield of 4.2 SCF/lb COD (chemical oxygen demand) added. This methane yield was achieved with an inoculum from an existing digester being fed product water from wet carbonization of peat. Bench-scale tests were continued in complete mixed, upflow, and attached-film digesters to evaluate performance and to determine the best reactor configuration for treating the product water. A new expanded-bed digester was installed.

40329 **(DOE/MC/21225—2240) Wet carbonization of lump-size low-rank coals by a novel non-slurry approach: Progress report for the period May-July 1986.** Lau, F.S.; Roberts, M.J.; Srivastava, V.J.; Mensinger, M.C.; Janulis, J.A.; Rue, D.M. (Institute of Gas Technology, Chicago, IL (USA)). Oct 1986. Contract AC21-84MC21225. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003415.

Construction of the process research unit (PRU) was completed with the successful modification and shakedown testing of

the high-pressure steam boiler. Following an initial shakedown test of the PRU, four wet carbonization tests were conducted: a test (86-PRU-1) to determine the wet carbonization characteristics of (-1+1/2 inch) North Dakota Indianhead lignite, a replicate test (86PRU-2) to determine reproducibility of data, a test (86PRU-3) to determine the effect of residence time, and a test (86PRU-4) to determine the effect of partial wet oxidation using air feed to the reactor. The PRU and ancillary equipment operated smoothly, and system temperature and pressure controls operated well. The operating conditions for the four tests were a residence time of 0.3 to 1.1 hours and a temperature of about 550°F. Air was used in the fourth test as a means of providing a portion of the required process heat. Product solid, liquid, and gas samples were taken for analyses. Two successful tests were conducted in the free-fall devolatilization reactor with raw Texas lignite and Montana subbituminous coals. These tests were conducted at a temperature of 1300°F and a pressure of 500 psig with a steam-hydrogen mixture (50 mole percent hydrogen). About 150 grams of coal were fed during the 60-minute duration of the tests. The product solid, liquid, and gas samples from the tests are being analyzed. Anaerobic digestion tests continued with filtered product water from the batch wet carbonization unit and the PRU. The objective of these tests is to determine the preferred reactor configuration and operating conditions for producing methane from and reducing the chemical oxygen demand of the wet carbonization product water.

40330 **(DOE/MC/22058—2232) Rapid pyrolysis with steam stabilization: Quarterly report for June 1986-August 1986.** (Avco-Everett Research Lab., Everett, MA (USA)). 1987. Contract AC21-85MC22058. 32p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87003881.

To insure the reliability of the coal conversion as well as carbon balance closure data, the feed flow rates and gas chromatograph response factors were recalibrated. Experiments were carried out with Zap A (lignite), Montana Rosebud (sub-bituminous), Pittsburgh No. 8 (bituminous) and Illinois No. 6 (bituminous) coals. For pre-designated flow conditions as per the test plan, char slurry and soot samples were collected. The char slurry samples were filtered and analyzed. Data of coal carbon conversion and pyrolyzed temperature as a function of coal loading, residence time and gas inlet temperature are presented. Good agreement between the gas compositions and coal carbon conversions was found at the pyrolyzer exit and cyclone exit indicating that the gas samples in the pyrolyzer and the char samples collected at the bottom of the cyclone are truly representative. The coal carbon conversion obtained from the char analysis using ash tracer technique indicated good agreement with that from the gas analysis. The reproducibility of the data was checked and was found to be fairly good. The char slurry samples were filtered and analyzed and from that the carbon balance closure was checked. To study the effect of particle size, experiments were carried out with 70% - 200 mesh and 95% - 325 mesh Rosebud coals. The coal carbon conversions were found to be similar in both cases. All of the data presented are in preliminary form, and will be subjected to further analysis before inclusion in the final report. 15 figs., 3 tabs.

40331 **(DOE/PC/70006—T8) Enthalpy and phase behavior of coal derived liquid mixtures: Technical progress report for the period April-June 1987.** Yesavage, V.F.; Kidnay, A.J. (Colorado School of Mines, Golden (USA). Dept. of Chemical Engineering and Petroleum Refining). 31 Jul 1987. Contract FG22-84PC70006. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013085.

On July 15, 1984, work was initiated on a program to study the enthalpy and phase behavior of coal derived liquid model compound mixtures. During the twelfth quarter, enthalpy measurements for the compound of 1-methylnaphthalene have been completed and are included in Table 1. 16 refs., 5 figs., 4 tabs.

40332 **(DOE/PC/70031—T1) Novel carbon molecular sieve catalysts for wax suppression in the Fischer-Tropsch reaction: Final technical report.** Foley, H.C. (American Cyanamid Co., Stamford, CT. Chemical Research Div.). Jun 1987. Contract AC22-84PC70031. 186p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE87011690.

The Type I and II IOM-CMS versions of the FT catalyst displayed both markedly improved on-stream behavior as well as a different product distribution than the untreated FT catalyst. Comparative results for IOM-CMS catalysts versus the untreated catalysts, indicate that they make predominantly lighter hydrocarbons and in reasonably high yields. (C1 to C4, >80%, ~100 to 170 gm hydrocarbon/m^3 synthesis gas converted). In these catalysts the combined Fischer Tropsch/Hydrocracking (FT/HC) functionalities are in 1:1,3:1, and 6:1 (w/w) ratios, and are in the form of C-FT-HC TY-I, C-FT-HC Non-Sieving, and FT-HC (native). These systems were very well-behaved in the fixed bed mode, operation without clogging or sintering during the course of extended runs (>150 hrs). In summary, the IOM-CMS materials have been demonstrated with a wide variety of compositions and different adsorptive properties. Catalysts prepared with the IOM-CMS materials showed improved properties relative to the untreated Fischer-Tropsch catalysts. The formation of the carbon molecular sieving function did not deactivate the catalysts. In fact, the IOM-CMS forms of the catalysts were better behaved, displaying improved resistance to sintering and or clogging. Catalysts tested to-date showed high selectivities to the very short chain hydrocarbons, C1 to C4, but not to the gasoline fraction, C5 to C11. This may be due to the fact that the pore properties of the materials tested were in the 3A to 4A range. Shifting of this pore size to slightly higher values may produce a concomitant shift in the product distribution. 39 refs., 39 figs., 20 tabs.

40333 **(DOE/PC/70801—T11) Thermodynamic properties for supercritical coal conversion: Quarterly progress report, 4/1/87-6/30/87.** Eckert, C.A. (Illinois Univ., Urbana (USA). Dept. of Chemical Engineering). 1987. Contract FG22-84PC70801. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012293.

The special properties of supercritical fluids include high density, high diffusivity, low viscosity, and high compressibility. The liquid-like density gives it a large capacity for solutes. The solubility of heavy organic solutes in SCF's is frequently many orders of magnitude greater than the solubility in an ideal gas. The ratio of these two solubilities is defined as the enhancement factor and values of 10^6 to 10^9 are quite common. The high diffusivity and low viscosity make it an efficient medium for mass transfer. Finally, the high compressibility permits extradordinary selectivity since small pressure changes yield large density changes and, consequently, large solubility changes. We have measured the solubilities of several representative coal compounds in supercritical ammonia at 142 C and 162 C. We conducted a comparison of the ability of four equations of state to predict solubilities of the compounds in SC CO_2, butane, and ammonia, and found that the PR2 and AVDW4 equations performed the best for these fluids. In addition, we conducted a search for new representative coal compounds that are better suited to higher temperature investigation. 7 figs., 3 tabs.

40334 **(DOE/PC/80502—T6) Interactive chemistry of coal-petroleum processing: Quarterly progress report for March 15, 1987-June 15, 1987.** Curtis, C.W.; Guin, J.A.; Tarrer, A.R. (Auburn Univ., AL (USA). Dept. of Chemical Engineering). 1987. Contract FG22-85PC80502. 70p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87013440.

The thermal reactions of model compounds NAPH, DMC, PN, BZT, and QN with Maya TLR (topped long resid) showed no reactions. The presence of Maya TLR blocked the intermediate hydrogenation pathway from QN to THQ compared to the reaction without Maya TLR where 13% THQ was formed. Maya TLR served as a strong inhibitor in the catalytic hydrogenations of model compounds, being more detrimental to the hydrogenation and heteroatom removal reactions than coal. The severe inhibition of Maya TLR is caused by the chemical composition of the resid. The resid contains large refractory hydrocarbon species and substantial amounts of metals. Maya TLR was most likely deactivating the $NiMo/Al_2O_3$ catalyst as well as possibly interacting with model species present. Catalyst deactivation due to pore-plugging by petroleum crude and residua reaction products from hydrotreating, i.e., metal sulfides and coke has been studied by Newson. In crude oils and residua, vanadium and nickel compounds are the most abundant organometallic constituents and cause major problems in hydrotreating of residuum oils. At hydroprocessing conditions, these metal compounds deposit on and deactivate the catalyst. Pore mouth plugging in the catalyst by the metal deposit has been

known as the major cause in the catalyst deactivation. Tamm and co-workers studied two mechanisms of catalyst deactivation by petroleum feed metals: (1) poisoning of the active surface and (2) physical obstruction of the pore structure. Thus, two possible reasons for the severe deactivation observed in the Maya TLR are metal deposition and carbon laydown on the catalyst surface. Another reason why the Maya TLR had a stronger inhibiting effect than coal is that these reactions are at 350°C, where the coal was only partially dissolved; therefore, all the bad actors from coal were not available in the system, while those from the resid were. 3 refs., 4 figs., 36 tabs.

40335 **(DOE/PC/80507—T7) Catalytic coal gasification: Identification of active sites: Reporting period, April 15, 1987-July 14, 1987.** Falconer, J.L.; Lauderback, L.L. (Colorado Univ., Boulder (USA)). 31 Jul 1987. Contract FG22-85PC80507. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012971.

This research uses transient isotope tracing, at steady-state reaction conditions, in combination with surface analysis techniques (secondary ion mass spectrometry (SIMS) and x-ray photoelectron spectroscopy (XPS)). Carbon dioxide gasification of carbon blacks and coal char will be used initially, since this appears to be rate-determining during steam gasification; steam gasification will be used in later experiments. In a typical isotope tracing experiment, $^{12}CO_2$ flow over a carbon-catalyst mixture will be quickly replaced by $^{13}CO_2$ at the same pressure and flow rate. The changes in the concentrations of ^{12}CO and ^{13}CO products, and in the $^{12}CO_2$ and $^{13}CO_2$ concentrations, as a function of time, will be measured with a computer-controlled mass spectrometer. The use of isotope transients allows the concentration of active catalytic sites to be measured directly at reaction conditions and it allows the rate constant to be measured. Isotope tracing will be carried out as a function of reaction temperature, catalyst loading, catalyst type and carbon conversion. Surface analysis techniques will be used to determine the active forms of the catalysts. Model studies of catalyst-carbon interactions will also be carried out with SIMS in order to determine the form of surface species. The combination of isotope tracing and surface analysis will elucidate the details of the reaction mechanism. This insight into the mechanism of coal gasification will help in improving process kinetics for gasification.

40336 **(DOE/PC/80907—T6) Reactivity of coal in direct hydrogenation processes: Technical progress report, March-May 1987.** Baldwin, R.M.; Miller, R.L. (Colorado School of Mines, Golden (USA). Dept. of Chemical Engineering and Petroleum Refining). 1987. Contract FG22-85PC80907. 24p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012377.

Research during the past quarter centered on continuation of two facets related to the study of coal reactivity in direct hydrogenation liquefaction processes. Five coals from the Argonne Premium coal collection were liquefied at three temperature levels in order to gather data for kinetic analysis purposes. Conversion of these coals to THF-, toluene-, and hexane-solubles was determined at temperatures of 425, 400, and 375 C, and nominal reaction times of 3, 5, 10, 15, and 40 minutes in the microautoclave batch reaction system. Preliminary mathematical modeling of the data using simple irreversible rate expressions and more complex formulations based on a statistical distribution of activation energies was initiated in order to investigate the feasibility of utilizing activation energy as an additional reactivity screening factor. Use of complex models such as the Anthony-Howard formulation for purposes of activation energy determination from liquefaction data at one temperature level was further examined. Five of the 21 coals from the Penn State Premium coal sample bank were liquefied at the standard reactivity screening conditions, and the rate and extent of conversion to THF-, and toluene-, and hexane-solubles quantified. These data were added to the existing data base containing similar information for the prior coal suites from the Exxon and Argonne collections, and preliminary correlational efforts for reactivity vs. coal properties were initiated. Prior conclusions regarding the effect of rank on the rate and extent of conversion were qualitatively verified from the data collected. 1 ref., 13 figs., 2 tabs.

40337 **(DOE/PC/90912—T3) Low severity coal liquefaction to determine reactivity of coals: Technical progress report No. 3 for period 12/1/86 through 2/28/87.** Chung, K.E. (Rockwell International Corp., Thousand Oaks, CA (USA). Science Center). Jul 1987. Contract FG22-86PC90912. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012292.

The objectives of this investigation are (1) to determine the reactivity of bituminous coals for liquefaction using moderate temperature hydrogenation, and (2) to examine the reaction chemistry involved in the moderate temperature liquefaction as a function of reaction time, temperature and catalyst application. The experimental work involves hydrogenation of a bituminous coal at 325°C in the absence of a donor solvent and catalyst. Then, the effect of reaction temperature and catalysts will be studied at temperatures between 300 and 350°C using two catalysts, FeS_2 and ammonium molybdate. The effects of reaction time and temperature on the hydrogenation of an Illinois bituminous coal have been examined. Four reactions were carried out at 325°C under H_2 pressure of 2900 psig for 1.5, 3, 14 and 27 h. Two additional reactions were conducted at 300 and 350°C for 3 h. Product composition changed with the reaction time. The oil:asphaltene:preasphaltene ratio was 2:3:1 in the 14 and 27 h reactions. With shorter reaction periods, the yields of C_1-C_2 gas, oil and asphaltene decreased to a similar extent, while preasphaltene yield increased moderately and residue yield increased drastically. This product distribution reveals that the coal was converted mainly by a parallel formation of oil, asphaltene and preasphaltene followed by some sequential formation of oil and asphaltene from preasphaltene. IR spectra of some product fractions obtained in 1.5 and 3 h reactions showed strong, sharp absorptions due to aryl-alkyl ethers or weak, well-resolved absorptions due to carbonyl groups. The separation and identification of aryl-alkyl ether groups are of great significance for the structure/reactivity studies. 3 refs., 5 figs., 3 tabs.

40338 **(EPRI-AP—5045) Coal pyrolysis for utility use: Final report.** McKinsey, R.; Luebke, C.P.; Thelen, H.J.; ya Nsakala, N.; Riegel, H. (Bechtel Group, Inc., San Francisco, CA (USA); Veba Oel Entwicklungsgesellschaft G.m.b.H., Gelsenkirchen (Germany, F.R.); Lummus Crest, Inc., Bloomfield, NJ (USA); UOP, Inc., Des Plaines, IL (USA); Combustion Engineering, Inc., Windsor, CT (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jul 1987. 200p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920528.

EPRI undertook an extensive research effort to evaluate the viability of coal pyrolysis products for utility use. The objectives of the studies were to evaluate the combustion and storage characteristics of pyrolysis char and to evaluate the upgrading potential of pyrolysis liquid products (tar). To achieve these objectives, it was necessary to produce sufficient quantities of the char and tar in a process unit large enough to produce commercially representative products. For both technical and availability reasons, EPRI selected the Lurgi-Ruhrgas (L-R) process for the production run (under subcontract to Bechtel Group, Inc. RP2505-2). Several contractors were to do the liquid upgrading. Two contractors were selected to use alternative processes for upgrading the L-R heavy tar: Lummus-Crest, Inc. (RP2505-5), using its LC-fining technology, and Veba Oel (RP2505-6), using its Combi-Cracking process. (The Combi-Cracking process also simultaneously hydrotreats the coal-tar-derived distillates.) Universal Oil Products, Inc. (UOP) was selected to hydrotreat the light and middle oils from the L-R process (RP2505-7), as well as the distillable material produced by Lummus. Unfortunately, none of these contractors received the anticipated products. The light oil was in the form of a light oil-water emulsion and the middle oil had been blended with the solids-laden heavy oil during L-R operation. Combustion Engineering, Inc. carried out a two-phase program to evaluate the combustion characteristics of pyrolysis char (RP2505-4).

40339 **(EPRI-AP—5340) Advanced air separation for coal gasification-combined-cycle power plants: Final report.** Kiersz, D.F.; Parysek, K.D.; Schulte, T.R.; Pavri, R.E. (Union Carbide Corp., Tonawanda, NY (USA). Linde Div.; General Electric Co., Schenectady, NY (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Aug 1987. 73p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920547.

Union Carbide Corporation (UCC) and General Electric Company (GE) conducted a study to determine the benefits associated with extending the integration of integrated coal gasification-combined cycle (IGCC) systems to include the air separation plant which supplies oxygen to the gasifiers. This is achieved by extracting air from the gas turbine air compressors to feed the oxygen plant and returning waste nitrogen to the gas turbine. The "Radiant Plus Convective Design" (59°F ambient temperature case) defined in EPRI report AP-3486 was selected as a base case into which the oxygen plant-gas turbine integration was incorporated and against which it was compared. General Electric Company's participation in evaluating gas turbine and power block performance ensured consistency between EPRI report AP-3486 and this study. Extending the IGCC integration to include an integrated oxygen plant-gas turbine results in a rare combination of benefits - higher efficiency and lower capital costs. Oxygen plant capital costs are over 20% less and the power requirement is reduced significantly. For the IGCC system, the net power output is higher for the same coal feed rate; this results in an overall improvement in heat rate of about 2% coupled with a reduction in capital costs of 2 to 3%. 6 refs., 11 figs., 7 tabs.

40340 (LBL—22151, pp 1.18-1.20) **Removal of H_2S from coal-derived gases.** Lynn, S.; Hix, R.; Neumann, D.; Sciamanna, S.; Stevens, C. Mar 1987. NTIS, PC A02/MF A01. File Number DE87009270. Contract AC03-76SF00098.

In Energy Conversion and Storage Program: FY 1986, Annual report.

When coal is gasified, most of the organic sulfur is converted to hydrogen sulfide. The problem of removing the hydrogen sulfide varies with the nature of the gas that has been produced and with the purpose to which the gas is to be put. A new process is being developed which consists of: absorbing the hydrogen sulfide in a polar organic solvent; converting the dissolved hydrogen sulfide to sulfur by reacting it with an equivalent amount of sulfur dioxide dissolved in the same solvent; recovering elemental sulfur from the solvent by crystallization; and generating the sulfur dioxide for the process by burning hydrogen sulfide or sulfur, recovering heat from the combustion gas in a waste-heat boiler and recovering sulfur dioxide by scrubbing the gas with cooled solvent from the crystallization step. The process under development has a number of potential advantages over conventional technology. These include reduced capital and operating costs, great design flexibility, high H_2S removal efficiency, and applicability to the treatment of a wide variety of gases. The overall objectives of this project are to obtain the physical and chemical data needed to design process configurations for treating gas streams of interest, and to evaluate these process configurations to determine their economic potential.

40341 (LBL—22151, pp 1.20-1.21) **Analysis of coal gasification reactors.** Denn, M.M.; Dow, G. Mar 1987. NTIS, PC A02/MF A01. File Number DE87009270. Contract AC03-76SF00098.

In Energy Conversion and Storage Program: FY 1986, Annual report.

Moving-bed coal gasifiers are designed to operate in either a dry-ash mode, as in the METC and commercial Lurgi gasifiers, or in a slagging mode, as in the BCG/Lurgi slagging gasifier. Dry-ash gasifiers require large amounts of excess steam for temperature moderation, and are therefore inefficient. Flagging reactors are not yet a commercial technology, and they are faced with both materials problems and problems of bed movement. This research project has been concerned with the modeling of moving-bed gasifiers, in order to gain insight into reactor operability and design. All modeling efforts require the use of a single-particle model, which describes the local mass and heat transfer and chemical kinetics in the heterogeneous system. The most realistic descriptions of transport phenomena and chemical kinetics near the reactive coal surface seem to be contained in detailed single-particle models, which predict the formation of a flame front under some reaction environments. The focus of the work currently being carried out is to explore the way in which the assumptions made in a detailed single-particle model are integrated into a complete reactor model. The major concern is with the development of a flame front, where the point of maximum temperature leaves the solid surface and enters the bulk gas.

40342 **(NP—7770233) Investigations on the direct conversion of coal to gaseous hydrocarbons in an helium and hydrogen plasma jet at temperatures of 1000 to 2000/sup 0/C.** Beiers, H.G. (Essen Univ. (Gesamthochschule) (Germany, F.R.). Fachbereich 8 - Chemie). 28 Nov 1985. 180p. (In German). NTIS (US Sales Only), PC A09. File Number DE87770233.

The investigations were carried out in a helium and a hydrogen plasma jet at temperatures of 1000 to 2000/sup 0/C and at a pressure of 1 bar. Apart from the Westerholt gas flame coal (grain size 95% less than 140 μm and 80% greater than 80 μm), some selected gaseous and liquid hydrocarbons were used. The following picture of the plasma pyrolysis of coal is obtained from the experiments and model calculations: The coal is heated with speeds above 10/sup 5/ k/sec to about 800/sup 0/C. Volatile components are released above this temperature. The coal used has finished reacting after about 4 milliseconds. About 55% of the carbon has then become volatile, and this is regardless of the plasma temperature. At temperatures above 1500/sup 0/C, acetylene is the main gaseous product. However, it is not formed directly from the coal. The formation of the acetylene takes place via a very reactive tar-like substance as an intermediate product. With rising temperature, the conversion of the 'primary tar' into gaseous products, especially into acetylene, increases.

40343 **(NP—7770239) Investigations on process optimisation in high-temperature coking of compressed coal.** Hess, J.C. (Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Chemieingenieurwesen). 12 Jul 1986. 194p. (In German). NTIS (US Sales Only), PC A09. File Number DE87770239.

The process parameters of coking under pressure are investigated. The process parameters are: The charge and its properties, the flue temperature, and the coke oven geometry. Laboratory measurements, semi-industrial and industrial-scale measurements were carried out. Using a mathematical model, the temperature curve across the coke oven charge was calculated with the assumption of purely one-dimensional heat transfer.

40344 **(NP—7770241) Development of a numerical model for simulating a very thin high-temperature zone in coal in-situ gasification with gasification agents containing oxygen or water vapour.** Kassler, P. (Technische Univ. Clausthal, Clausthal-Zellerfeld (Germany, F.R.). Fakultaet fuer Bergbau, Huettenwesen und Maschinenwesen). 23 Jun 1986. 145p. (In German). NTIS (US Sales Only), PC A07. File Number DE87770241.

The development of in-situ gasification to its present status is outlined. In Western Europe, it is particularly suited for deep strata that are not accessible by conventional means. The potential and limits of the modelling procedure are outlined with a view to process development.

40345 **(ORNL/FETEP—20) Adsorption studies evaluating codisposal of coal gasification ash with wastewater sludges containing polycyclic aromatic hydrocarbons.** Kilmer, J.W.; Minear, R.A.; Francis, C.W. (Oak Ridge National Lab., TN (USA)). Jun 1987. Contract AC05-84OR21400. 181p. NTIS, PC A09. File Number DE87013378.

The extent to which polycyclic aromatic hydrocarbons (PAHs) are sorbed onto gasifier ash was investigated in batch and column sorption studies. The batch studies involved characterizing the adsorption and desorption of phenanthrene, anthracene, benzo[a]pyrene, and quinoline on gasifier ashes from four coal gasification processes. The surface area of ashes ranged from <1 to >30 m^2/g. Isotherms representative of adsorption and desorption

over wide ranges in equilibrium concentrations of the PAHs were determined. Five sorption models, Freundlich, Langmuir, Henry's Law, BET (Brunauer, Emmett, and Teller), and Redlick-Peterson were examined to determine which model best described the adsorption/desorption characteristics of the PAHs on the ashes. Regression analyses indicated that the Freundlich and Langmuir models were more descriptive than either Henry's Law or the BET model. To evaluate the sorption of PAHs on gasifier ashes in a landfill scenario, organic wastes known to contain leachable quantities of PAHs were placed in 5-cm-diam columns overlying various quantities of gasifier ash. The columns were continually leached with distilled water over 3 months, representing greater than 80 column volumes over the duration of the study. Both the batch and the column results indicated that a significant portion of the PAHs sorbed on gasifier ashes was tightly bound or desorbed at a very slow rate. The rate at which this desorption occurs is very critical. For example, if the rate is slow enough to allow degradation, codisposal of wastewater sludges with gasifier ash may be an effective method of disposal. However, before such disposal is implemented, long-term (5- to 10-year) field studies should be conducted to evaluate potential releases of PAHs to groundwater under real-world conditions.

40346 **(ORNL/SGMP—87/1) Surface Gasification Materials Program: Semiannual progress report for the period ending March 31, 1987.** (Oak Ridge National Lab., TN (USA)). Jul 1987. Contract AC05-84OR21400. 48p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013353.

The objective of the Surface Gasification Materials Program is to conduct research and development on materials for application to the specific needs of coal gasification systems. One of the goals of the program is to evaluate innovative fabrication methods which have the potential to lower costs and improve reliability and safety for gasifier vessels and components. Another goal is to conduct engineering-scale development and application of materials for coal gasification systems to ensure that the materials of construction for pilot plants and future large-scale plants can be properly selected and specified. The management of the Program has been decentralized to DOE field offices. The Morgantown Energy Technology Center (METC), in its lead role for gasification projects, is responsible for ensuring that the Surface Gasification Materials Program is responsive to the needs for gasification systems. The ORNL Fossil Energy Materials Program Office compiles and issues this combined semiannual progress report from camera-ready copies submitted by each of the participating organizations.

40347 **Step-wise supercritical extraction of carbonaceous residua.** Warzinski, R.P. (to Dept. of Energy, Washington, DC). US Patent 4,675,101. 23 Jun 1987. Filed date 15 May 1986. vp.

A method is described of fractionating a mixture containing high boiling carbonaceous material and normally solid mineral matter comprising: contracting the mixture in mass transfer relation with a first solvent including toluene at temperature and pressure above critical values for the solvent to extract a first solute containing a major fraction of the carbonaceous material into supercritical phase with the first solvent while leaving a first residual fraction; reducing the pressure of the first solvent with solute to below the critical pressure of the first solvent to release from supercritical phase the first solute as a first released liquid and the first solvent as a gas; compressing the solvent gas to above its critical pressure for recycle into contact with the mixture; contacting the first released liquid with a second solvent different from the first solvent at a temperature and pressure above critical values to extract a second solute into supercritical phase with the second solvent leaving a second residual fraction; the second solvent including cyclohexane and having a critical temperature less than that of the first solvent, and reducing the pressure of the second solvent with solute to below the critical pressure of the second solvent to release from supercritical phase the second solute as a second released liquid and the second solvent as a gas. The second released liquid being of higher average volatility than the first released liquid; compressing the second solvent gas to above its critical pressure for recycle into contact with the liquid.

40348 **Coprocessing of coal with heavy petroleum crudes and residua.** Curtis, C.W.; Guin, J.A.; Pass, M.C.; Tsai, K.J. (Chemical Engineering Dept., Auburn Univ., Auburn, AL 36849). *Fuel Science and Technology International;* **5**: No. 3, 245-274(1987).

This work investigates the coprocessing of coal in six different heavy petroleum crudes and residua. Coprocessing reactions of coal and the petroleum solvents are performed under three sets of constant reaction conditions, yielding informative comparative data for processing applications. Definitive comparisons of coal reactivity and solvolysis in the petroleum solvents have been obtained using solvent fractionation which provides a measure of the degree of upgrading achieved by the liquefied coal. Regressive reactions and low coal conversions are observed in coprocessing reactions in N/sub 2/ at 400°C. Higher conversions and a reduction in regressive reactions are observed in H/sub 2/ at 400°C. Catalytic hydrotreatment and higher temperature, 425°C, result in increased coal conversion and a net production of pentane soluble materials.

40349 **Generation, control, and recovery of organic pyrolysis products in underground coal gasification.** Glaser, R.R.; Owen, T.E. (Western Research Institute, Laramie, WY 82071). *Fuel Science and Technology International;* **5**: No. 3, 275-290(1987).

The organic chemical substances present in UCG-affected subsurface waters are formed by the thermal degradation of coal. After a UCG reactor is shut down, the sensible heat contained in the rubble pile is sufficient to continue coal pyrolysis. If the pyrolysis products are not removed, they become a potential source of subsurface water contamination. Heat transfer into the coal seam and migration of chemical substances after reactor shutdown can be substantially reduced by a controlled influx of water through the cavity side walls and removal of produced fluids from the reactor.

0106 Properties

REFER ALSO TO CITATION(S) 40320, 40331, 40333

40350 **(DOE/FC/10627—2274) Surface adhesion of low-rank coal ash: Quarterly report, July 1, 1986-September 30, 1986.** Austin, L.G.; Conn, R. (Pennsylvania State Univ., University Park (USA). Coll. of Earth and Mineral Sciences). Dec 1986. Contract AC21-85FC10627. 20p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87006034.

The Beulah-Zap lignite ash had relatively low deposition rates after combustion in air and 60% O_2. This coal had a very high sodium content (10.4 wt % Na_2O in ASTM ash), but a relatively high ash initial deformation temperature (1295°C). The fluid temperature (1305°C) was only 10°C higher. The deposit produced after combustion of the lignite in air at 1500°C only developed strength as the deposit grew to within a few millimeters of the constrictor. At this point, the gas temperature (1250°C) was near the ash fusion temperatures and considerable melting had occurred. Gas velocity was observed to increase ash deposition rate and strength for Center lignite. At the furnace exit, the products of combustion pass through the constrictor and impinge on the substrate. Particles in this aerosol stream having a great enough inertia will impact upon the substrate, and smaller particles will pass as an aerosol around the substrate out of the probe. By increasing the gas velocity at the constrictor, smaller diameter particles will be collected on the substrate. The particle size distribution of the fly ash collected on the substrates was found to decrease as the gas velocity was increased. The highest gas velocity which is practical in the drop tube is ~16 m/sec, which can be obtained using a 1/4″ constrictor. This velocity is similar to those encountered in a utility boiler convective section. It is proposed that any future drop tube tests for simulating convective section ash fouling should be conducted with gas velocities greater than 15 m/sec. The electric drop tube furnace with extension gas heater can provide a gas time-temperature history, which is similar to that of a low rank coal boiler convective section.

40351 (DOE/MC/21313—2222) Reaction kinetics and physical mechanisms of ash agglomeration: Progress report for the period February 24-May 23, 1986. Carty, R.H.; Mason, D.M.; Babu, S.P. (Institute of Gas Technology, Chicago, IL (USA)). Aug 1986. Contract AC21-84MC21313. 33p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87003859.

The long-term objective of the ash particle dynamics studies is to elucidate the physical conditions under which ash particles deposit or agglomerate. Of particular interest are the results of particle-particle and particle-wall collisions. The outcomes of such collisions will depend on ash particle composition, temperature, viscosity, surface tension, diameter, momentum, and impact parameters. The possible results of collisions include agglomeration, deposition, and shattering. To investigate the effects of these collisions, the DEM technique is being used. A cold-flow model of this device is being constructed and used to accelerate and aim the particles, measure their incoming and exiting angles, and observe the results of collisions. The modified dielectrophoretic manipulator (DEM) power supply has been tested. The new power supply operates at 800 (compared to the former 200) volts. It also distributes the voltage to the individual electrodes through a bank of relays that are manually controlled by a rotary multi-pole switch. This design will facilitate transition to computerized operation because the rotary switch can be readily replaced with a computer interface. The movement of particles during these tests was more reproducible than the movement during the lower voltage tests. Performance has been improved by removing the glass plates that prevent particles from contacting the electrodes. This places the particle in higher field gradient regions, but increases the probability of arcing. The unit cannot be used with conducting particles, but this poses no difficulty for ash experiments. This configuration can be tested with glass spheres. The presence of static charges or surface bonding is restricting the free movement of particles.

40352 (DOE/PC/70764—7) Effect of in-situ heat treatment on coal char reactivity: Final report, March 14, 1986-June 30, 1987. Basak, A.K.; Essenhigh, R.H.; Bailey, E.G. (Ohio State Univ., Columbus (USA). Dept. of Mechanical Engineering). Jun 1987. Contract FG22-84PC70764. 270p. NTIS, PC A12/MF A01; 1; GPO Dep. File Number DE87010575.

The primary objective of this study was to examine the possible influence of in-situ heat treatment on char reactivity. The postulate is, therefore, one of "rapid graphitization" (heat treatment results in graphitization), and it will be amply supported if the results, from the heat treatment experiments in the high intensity flame, show that by introducing a short heat treatment time there is a shift in the reaction dominating mechanism from diffusion control, as was found by Farzan and Liu, to kinetic control. Overall, the hypothesis of rapid graphitization is supported. This conclusion can be drawn from the results since, for all the coals, unstaged combustion produced fast reactions, with boundary layer diffusion being the rate determining step. When staging was introduced, the reaction, after the heat treatment, became very slow and the chemical kinetics seemed to be the rate controlling mechanism then. Therefore, the very short heat treatment times, of the order of a few hundred milliseconds, reduced the reactivity of the flame-formed char. An exception to this general conclusion was for heat treatment in a highly fuel-rich environment where the char retained its initially high reactivity, even after significantly long heat treatment times. Further work is needed to understand the mechanism for this behavior, though it appears that the lower temperatures in the fuel rich mixtures may be responsible for this deviation. 52 refs., 66 figs., 6 tabs.

40353 (DOE/PC/90751—T2) Transformations of inorganic coal constituents in combustion systems: Quarterly report No. 3 for the period April-June 1987. (Physical Sciences, Inc., Andover, MA (USA)). 28 Jul 1987. Contract AC22-86PC90751. 73p. (PSI—1024/TR-693). NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87012984.

The specific technical objectives of this project are: (a) To: (1) define the partitioning of inorganic constituents associated with raw coal particles among products (including vapors, aerosols, and residual char/ash particles) formed under conditions representative of pulverized coal flames as a function of the specific (intrinsic and extrinsic) characteristics of the raw coal and the environment in which the transformations occur; and (2) to characterize the resultant spectrum of products in detail. (b) To elucidate and quantify the fundamental processes (involving basic principles of physics, chemistry, thermodynamics) by which transformations of the inorganic constituents occur. (c) To develop, based on the information required in a. and b. above, a tractable "process" model capable of predicting the significant features of the transformation process, most importantly, the distribution and nature of products. The contract approach and a description of each task is included in section 1 of this report and a schematic illustration of the Work Breakdown Structure is given. 23 refs., 14 figs.

40354 (DOE/PC/90913—T2) Biochemical bond breaking in coal: Third quarterly report, [April through June 1987]. (Atlantic Research Corp., Alexandria, VA (USA)). Jul 1987. Contract FG22-86PC90913. 20p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012235.

Major research efforts are presently being conducted in three principal areas of focus: (1) optimization of coal biosolubilization; (2) characterization of the solubilized products resulting from microbial coal depolymerization; and (3) degradation of model compounds to assess potential interunit linkages which may be attacked by whole culture or cell-free culture supernatants containing extracellular enzymes. Initial evaluations of the various combinations of microbes, coals, and coal pretreatments indicated that CP1 and CP1 + 2 solubilized all of the coals selected for this project at substantially higher rates than S. setonii or T. versicolor. The ARC CP1 + 2 consortium was chosen as the primary culture for detailed evaluation of coal biosolubilization and model compound degradation. Studies were conducted to determine if solubilization of coal by CP1 + 2 supernatants could be enhanced by elevating the temperature. Solubilization of both untreated Leonardite and HNO_3 treated Wyodak (Smith-Roland) subbituminous coal was increased when elevating the temperature from ambient to 35°C. The initial solubilization rate (T_0 - 1 hour) of Leonardite at 22°C was 16 OD units/hour and at 35°C was 18 OD units/hour. Thus, an elevation of 13°C enhanced solubilization of this coal by 12.5%. The effect of temperature on solubilization of Wyodak coal appeared to be more pronounced. Solubilization of HNO_3 treated coals by the CP organisms is not only relatively rapid, but is also extensive. The relatively rapid and extensive coal solubilization attainable by CP1 + 2 has enabled us to produce quantities of product sufficient for analytical methods development and for characterization of the coal products. Initial attempts have been made to characterize the depolymerized products using HPLC and GC/MS. 9 figs., 3 tabs.

40355 (LBL—22151, pp 1.22-1.26) Energy-related organometallic chemistry. Fish, R.H.; Reynolds, J.G.; Gallegos, E.J. Mar 1987. NTIS, PC A02/MF A01. File Number DE87009270. Contract AC03-76SF00098.

In Energy Conversion and Storage Program: FY 1986, Annual report.

Research studies in energy-related organometallic chemistry are reported. The work in this area is described in the following three topics: (1) molecular characterization of nickel and vanadium non-porphyrin compounds found in heavy crude petroleum and bitumens; (2) hydrodenitrogenation chemistry used in the refining of petroleum feedstocks; and (3) carbon-oxygen bond cleavage reactions of aromatic ethers and esters with potassium metal/18-crown-6 as the electron transfer reagent: a structure reactivity relationship for models in the depolymerization mechanism of coal.

40356 (PB—87-190906/XAB) Chemical and physical properties of coal. Van Vuuren, M.C.J. (National Inst. for Coal Research, Pretoria (South Africa)). Dec 1985. 26p. (COAL—8518). NTIS, PC PC E05/MF E05.

Coal is a heterogeneous mixture of organic and inorganic substances, each with its own properties, which vary considerably from coal to coal. These coal properties determine the ease that the coal can be graded and washed, and whether a given coal can be prepared economically for a defined market requirement. It is essential for a Coal Preparation Technologist to have a fundamental knowledge of the coal properties and hence a coal's utilization po-

tential. The paper examines the chemical and physical properties of coal.

40357 **(PNL-SA—14650) Applications of supercritical fluid chromatography-mass spectrometry in the analysis of fossil fuels.** Chess, E.K.; Kalinoski, H.T.; Wright, B.W.; Udseth, H.R.; Smith, R.D. (Pacific Northwest Lab., Richland, WA (USA)). May 1987. Contract AC06-76RL01830. 4p. (CONF-8705114—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013325.

From 35. conference on mass spectrometry and applied topics; Denver, CO, USA (24 May 1987).

Because the physical properties of a supercritical fluid (e.g., low viscosity, high diffusivity, and reasonable solubility, etc.) impart characteristics to the supercritical mobile phase intermediate to those of a liquid and a gas, SFC has allowed the separation of some components of complex mixtures that were not separable by gas chromatography or high performance liquid chromatography. The application of SFC-MS to the analysis of fossil fuels has been demonstrated primarily in our laboratories at Pacific Northwest Laboratory. One primary emphasis of our research programs involving fossil fuels analysis has been to develop supercritical fluids and chromatographic columns that can be used for the characterization of higher-molecular-weight (above 250 amu) and polar components of fossil fuels. Our research indicates that supercritical carbon dioxide is a reasonably poor solvent for PAH and polar-substituted PAH, and needs (at a minimum) to be modified with the addition of a few percent of a polar solvent, such as isopropanol, in order to solvate polar fossil fuels. Another primary emphasis has been the development of the SFC-MS interface and flow restrictor technology. Successful interfaces have been developed for coupling capillary columns to both quadrupole and magnetic sector mass spectrometers; a unique high flow rate interface for coupling packed microbore columns to a quadrupole instrument has also been developed. Our state of interface development is now such that SFC-MS can be used to analyze any high-molecular-weight compound that can be analyzed by GC-MS. The extension to components lacking the necessary volatility for analysis by GC-MS is now being realized with the application of polar-modified fluids. A variety of fossil fuels, including diesel fuels, diesel fuel sediments, coal-derived liquids, and porphyrins, have been analyzed by SFC-MS and related techniques. 13 refs.

40358 **(UCRL—96462) Investigation of the thermomechanical properties of coal subjected to heat treatment.** Britten, J.A.; Thorsness, C.B. (Lawrence Livermore National Lab., CA (USA)). 15 Jul 1987. Contract W-7405-ENG-48. 9p. (CONF-8708106—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013222.

From 13. annual underground coal gasification symposium; Laramie, WY, USA (24 Aug 1987).

Tensile strengths and coefficients of thermal expansion have been measured for four subbituminous coals of interest to underground coal gasification. These data are important in the context of understanding the interaction between the skin effect of thermal alteration at the walls and roof of a gasifying cavity with the external stress field in situ, which leads to the small scale spalling or rubblization behavior of coal observed from excavation of UCG cavities but not as yet reproduced in the laboratory. Results from the core measurement tests for Wyodak, Widco, Hanna and Brazilian coals show that shrinking behavior of these coals can generally be related to weight loss due to drying and pyrolysis, while the ultimate tensile strength as a function of temperature can be very different for the different coals and not necessarily related to proximate analysis differences. While it is the rule that subbituminous and lower grade coals generally suffer significant reductions in strength upon moderate heat treatment, further heating does not always result in continued loss of strength, and the strength some of these charred coals is not negligible as assumed by many investigators for modeling purposes. Experiments in which thermal alteration of the coal is combined with the application of external loads are required to study adequately this phenomenon in the laboratory. 14 refs., 3 figs., 9 tabs.

40359 **Correlation of coal and overburden mineralogy with inorganic constituents in UCG process effluents.** Oliver, R.L.; Mason, G.M.; Owen, T.E. (Western Research Institute, Laramie, WY 82071). *Fuel Science and Technology International;* **5**: No. 3, 329-356(1987).

Inorganic constituents present in UCG process effluents can be strongly correlated with changes in coal and overburden mineralogy. An analysis of the Hanna, Wyoming, UCG site provides insight on how inorganic constituents enter the system. A comparison of preburn versus postburn mineralogy indicates that carbonates, clay minerals, micas, and sulfurous minerals break down structurally because of high temperatures. This decomposition releases calcium, magnesium, silica, and aluminum for rebonding in high-temperature stable silicate and aluminosilicate minerals. It also replaces constituents such as iron, sodium, sulfur, and boron into the UCG process effluent. Other constituents such as calcium, copper, magnesium, manganese, potassium, and sodium are predominantly introduced into the groundwater by leaching.

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REFER ALSO TO CITATION(S) 40323, 40779, 40789, 40792, 41480

40360 (EPRI-CS—5167-Vol.1, pp 1.1-1.14) **Federal clean coal technology demonstration program.** Miller, C.L. (Dept. of Energy, Washington, DC). May 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920421.

In Proceedings: tenth symposium on flue gas desulfurization: Volume 1.

Clean Coal Technology has been defined as a generic term encompassing a variety of techniques for reducing SO_2, NO/sub x/ and/or particulates. The technology may be designed to be retrofitted on older boilers without modification or be primarily intended for new powerplant construction. The technology may be able to achieve New Source Performance Standards for one or more pollutants or achieve a more significant reduction in pollutant emissions. The technology may be projected to provide only a modest cost saving over current technology or a substantial saving. Finally, the technology may require several more years of development or it may be ready for demonstration now. In the context of these numerous technical and economic parameters, virtually all of the Department of Energy's (DOE) Coal R & D programs could be considered as constituting the Federal Clean Coal Program. This program and in particular the acid rain related research, costing over a half a billion dollars during the last six years (1982-1987) has focused on new innovative technologies that have the potential to remove sulfur oxides, nitrogen oxides, and particulate matter in greater amounts, more cost effectively, and in a more environmental acceptable manner than today's coal technology. However, it is not the objective to discuss the costs, effort, or concepts emerging from this R & D program, but it is to introduce the important associated newly initiated Federal Clean Coal Technology Demonstration Program.

40361 (EPRI-CS—5167-Vol.1, pp 1.15-1.20) **Ohio's clean coal technology.** Berger, D.A. (Ohio Coal Development Office, Columbus). May 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920421.

In Proceedings: tenth symposium on flue gas desulfurization: Volume 1.

Ohio has one of the nation's largest clean coal technology programs with more than $600 million in total project values underway or in negotiation. In support of this activity, the State of Ohio seeks to capitalize on its vast reserves of coal and its coal-dedicated electric utility plant that consumes in excess of 50.0 M/Tpy. Accordingly, clean coal technologies hold promise for improving market demand for Ohio high sulfur coal and reducing Ohio's sulfur dioxide/nitrogen oxide emissions. The program's foremost priority is in advancing clean coal retrofit technologies for application to existing coal-fired boilers. Ohio's approach keys on competitively solicited projects advanced by private firms and research institutions. Specifically, at risk financial participation by sponsors is sought and technology demonstrations are encouraged

in real world settings such as utility plants and industrial power houses. Two types of financial support are available from the Office. Direct grant or loan support may be awarded to projects from the $100 million state bond issue authorized for this activity. Current policy restricts OCDO support to a one-third share of demonstration projects and one-half share for pilot-scale facilities. Additionally, Ohio utilities may also submit projects for rapid expense treatment by the Ohio Public Utilities Commission. In this case, projects approved by the Office may be entitled to cost recovery treatment in filings made to the Commission every six months.

40362 (EPRI-CS—5167-Vol.1, pp 2.1-2.22) **Evolution of FGD technology.** Weir, A. Jr. (Southern California Edison Co., Rosemead). May 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920421.

In Proceedings: tenth symposium on flue gas desulfurization: Volume 1.

In 1970, the National Academy of Engineering (NAE) advised that There is an urgent need for commercial demonstration: of FGD systems and established a criteria of satisfactory operation on a 100 MW or larger unit for more than 1 year as the definition of proven industrial-scale reliability. The evolution of technology from the Large-Scale Development Failures in Sulfur Oxides Emission Control (NAE) to the highly efficient and reliable scrubbers of today is described.

40363 (EPRI-CS—5167-Vol.1, pp 2.23-2.43) **Trends in commercial applications of FGD.** Melia, M.T.; McKibben, R.S.; Jones, F.M.; Kelley, J.L. (PEI Associates, Inc., Cincinnati, OH). May 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920421.

In Proceedings: tenth symposium on flue gas desulfurization: Volume 1.

The status of utility flue gas desulfurization (FGD) technology since 1974 is reported. Information for this program is obtained through regular contacts with owner/operator utilities who are currently operating FGD systems or planning to install them. Supplemental information is also solicited from FGD system and equipment suppliers, design/engineering firms, research organizations, and regulatory agencies. The information collected is stored in the Flue Gas Desulfurization Information System (FGDIS). This data base contains computerized files of descriptive, design, performance, and cost data on all the FGD systems identified in the FGDIS. In addition to being used to generate periodic survey reports, the FGDIS is also available for immediate access via remote terminal. The status of FGD technology as of December 1985 is summarized. It highlights the status of the electric utility power industry, projected growth of coal-fired power generation, and the current status and future trends in FGD application. It also addresses performance of utility FGD technology with respect to both mechanical reliability and SO_2 removal efficiency in high- and low-sulfur coal applications, based on the design generation (age). Developments in system design, current operating experience, and operating and maintenance practices are discussed, as are impacts of the various regulatory classifications on FGD system design and operation.

40364 (EPRI-CS—5167-Vol.1, pp 2.45-2.66) **Status of acid rain and SO_2 and NO/sub x/ abatement technology in Japan.** Ando, J.; Sedman, C.B. (Chuo Univ., Tokyo, Japan). May 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920421.

In Proceedings: tenth symposium on flue gas desulfurization: Volume 1.

Yearly SO_2 emissions in Japan were reduced from 5 million tons in 1967 to 1.2 million tons in 1985, while the NO/sub x/ emissions were reduced from 2 million tons in 1973 to 1.3 million tons in 1985 by strenuous efforts including the construction of about 1500 flue gas desulfurization (FGD) plants and 200 plants for selective catalytic reduction (SCR) of NO/sub x/. The air quality has been remarkably improved but appreciable decline of needle-leaf trees is still observed in certain regions rich in oxidants and acid deposition. Efforts are continuing for further abatement of the pollutants. FGD and SCR technologies have been fairly well established, giving a high reliability of plant operation - more than 99% for FGD and virtually 100% for SCR. Recent efforts are made mainly on the improvement of existing technologies, rather than on the development of new processes. Improvements in FGD are seen in simplification and cost reduction, automatic control, and gas reheating. The life of SCR catalyst has proved to be 4-5 years for coal-, more than 6 years for oil-, and more than 8 years for gas-fired flue gases.

40365 (EPRI-CS—5167-Vol.1, pp 2.67-2.91) **Assessment of SO_2/NO/sub x/ emission control technology in Europe.** Ellison, W. (Ellison Consultants, Monrovia, MD). May 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920421.

In Proceedings: tenth symposium on flue gas desulfurization: Volume 1.

Updated details are presented of major flue gas desulfurization (FGD) and denitrification (de-NO/sub x/) installations in West Germany for coal-fired boilers. The status of technology in other European countries is also presented. The purposes of the study were to provide an understanding of the principal types of control system designs that have been applied, to outline technological advancements that have been achieved, and to review operating experience gained to date in expanded use of FGD and NO/sub x/ removal facilities in Europe in the 1980's. Significant difference from FGD service and practice in the US and Japan is described, and specific information that may serve to help improve operation and reliability of new and retrofit FGD installations in the US is offered. Principal topics include: a presentation of governmental emission control requirements in Europe for new as well as existing coal-fired sources; an overview of West German FGD and de-NO/sub x/ installations and purchase commitments including details of generic processes applied, operating history and current performance, and trends and developments in technology utilization; control of industrial boilers; management of solid and liquid waste by-products; and substantial activities in other European countries.

40366 (EPRI-CS—5167-Vol.1, pp 3.1-3.14) **Increasing the clarity of pollution abatement cost estimates.** Leggett, J.A.; Rubin, E.S.; Torrens, I.M. (Organization for Economic Cooperation and Development, Paris, France). May 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920421.

In Proceedings: tenth symposium on flue gas desulfurization: Volume 1.

Estimates of the costs of seemingly similar systems to reduce emissions of sulfur and nitrogen oxides (SO/sub x/ and NO/sub x/) often differ markedly when produced by different countries or organizations. To understand such differences requires provision of adequate supporting information on the methods and assumptions used to develop those estimates. The OECD has undertaken work recently both to summarize which data are most essential to provide, as well as to use examples of those data to analyze why cost estimates may differ so much. Data were supplied by the Umweltbundesamt (UBA) in Germany, the Electric Power Development Company (EPDC) in Japan, and the Electric Power Research Institute (EPRI) in the US; they cover similar flue gas desulfurization (FGD) and selective catalytic reduction (SCR) installations on coal-fired power plants. Initially, these cost estimates varied by factors of up to 5. After identifying differences in the scope of the estimates and the economic assumptions used, the OECD adjusted the original figures to make them more consistent with each other. This reduced the variation to factors of 2 or less. The findings suggest that additional care in providing supporting data when reporting cost estimates may help to reduce controversy in current debates over the cost burdens imposed by environmental regulations, and may point to ways by which emission abatement may be made more cost-effective.

40367 (EPRI-CS—5167-Vol.1, pp 3.15-3.34) **Economic evaluation of twenty-four FGD systems.** Keeth, R.J.; Ireland, P.A.; Moser, R.E. (Stearns Catalytic Corp., Denver, CO). May 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920421.

In Proceedings: tenth symposium on flue gas desulfurization: Volume 1.

The estimated costs for 24 throwaway and regenerable FGD systems based on December 1982 dollars and 1982-1986 process

technology are presented. In addition to costs, these systems were evaluated for operability, technical merit, and commercial availability. Most of the FGD systems were evaluated for application to a 4% sulfur coal fired in a hypothetical 1000 MW (two 500 MW units) power plant in Kenosha, Wisconsin. A reference plant was selected to ensure consistent comparisons, and to increase the relative accuracy of the costs presented. Dry FGD systems were evaluated for a low sulfur coal-fired plant. A flow sheet, material balance, equipment list, system description, and utility consumption list form the basis of each FGD evaluation. In each case, critical equipment has been spared, including one spare absorber module. Reheat of the flue gas (50°F) by indirect steam heating has been included in all wet systems.

40368 (EPRI-CS—5167-Vol.1, pp 3.35-3.54) **Plant specific retrofit factors for lime/limestone FGD and lime spray drying FGD.** Emmel, T.E.; Jones, J.W. May 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920421.

In Proceedings: tenth symposium on flue gas desulfurization: Volume 1.

A major factor affecting the cost and performance of SO_2 and NO/sub x/ controls for coal-fired power plants is the difficulty associated with retrofitting controls at existing boilers. The results of an ongoing program conducted under the National Acid Precipitation Assessment Program (NAPAP) by the US EPA's Air and Energy Engineering Research Laboratory are presented. The objective of this research program is to significantly improve engineering cost estimates currently being used to evaluate the economic effects of applying SO_2 and NO/sub x/ controls to existing coal-fired utility boilers. The retrofit cost procedures used for lime/limestone wet flue gas desulfurization (L/LS FGD) and lime spray dryer flue gas desulfurization (LSD FGD) is from the Electric Power Research Institute (EPRI) report entitled Retrofit FGD Cost-Estimating Guidelines (CS-3690). The procedures make two types of cost adjustments to new plant costs: cost adders and cost multipliers. Cost adders account for items not normally included in new FGD system costs such as demolition and relocation of existing facilities. Cost multipliers account for location factors such as labor productivity/cost and general retrofit factors such as access/congestion and underground obstructions. Retrofit capital costs developed using the EPRI detailed procedures are presented for one boiler. The retrofit costs were developed using information obtained from a one day site visit. Retrofit factors increased the base cost of building a new FGD unit by 69 to 90% for the two L/LS FGD cases and by 62 to 107% for the two LSD FGD cases. Access and congestion factors had the greatest effect and typically resulted in half of the increase over new plant costs. Scope adjustments such as new chimney and particulate control equipment and long flue gas duct runs also significantly increase FGD costs.

40369 (EPRI-CS—5167-Vol.1, pp 3.55-3.75) **Evaluation of flue gas desulfurization as an acid rain control strategy for utility coal-fired boilers in the State of Ohio.** Laseke, B.A.; Johnson, H.J.; Berger, D.A. (PEI Associates, Inc., Cincinnati, OH). May 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920421.

In Proceedings: tenth symposium on flue gas desulfurization: Volume 1.

The electric utility industry of the State of Ohio was the subject of an integrated research program sponsored by the US Environmental Protection Agency and the State of Ohio to evaluate air emission control techniques for acid rain precursors emitted by existing coal-fired utility boilers. The Ohio utility industry was selected for this investigation because of its heavy reliance on coal as a primary energy source, the relatively large number and associated generating capacity of existing coal-fired plants, the wide variety of plant design and operating configurations, the emission of acid rain precursors relative to national levels, and the potentially significant impact of the application of emission controls on the production and cost of electrical power. Two general categories of emission control techniques were considered - designated as active emission control techniques (i.e., methods which involve the addition of control equipment or systems) and passive emission control techniques (i.e., methods which do not require the addition of control equipment or systems). Site-specific boiler, fuel quality, and emission control system data were collected for all the coal-fired utility boilers in Ohio. Data collection was facilitated through a number of selective site visits to plants representative of the larger boiler population in Ohio. Detailed boiler and plant data were collected to estimate the technical feasibility, cost, and anticipated performance of FGD technology. The applicability of FGD for the Ohio utility boiler population was determined in terms of specific boiler costs, total cost, emission reduction, and overall cost effectiveness.

40370 (EPRI-CS—5167-Vol.1, pp 3.77-3.94) **Tennessee State Acid Rain (STAR) Project.** Bain, W.S. (Tennessee Valley Authority, Chattanooga). May 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920421.

In Proceedings: tenth symposium on flue gas desulfurization: Volume 1.

As a part of the State Acid Rain (STAR) program administered by the Environmental Protection Agency (EPA), the State of Tennessee proposed that the Tennessee Valley Authority (TVA) be used as a model to determine the effects of implementing acid rain controls on a large multi-State utility. Four possible strategies for implementing SO_2 reductions on the TVA system were analyzed: a cap on emissions for the TVA system as a whole, State-wide emissions caps on TVA plants in each of the three States where TVA plants are located, individual plantwide caps, and a plant emission-rate strategy. National reduction goals of 5, 10, and 12 million tons of SO_2 (1 ton = 0.907 metric ton) from utilities only were analyzed for high and low load electrical growth projections in the TVA region. Estimates were made of additional plant capital investments, annual operating costs, and percent increase in total revenue requirements for each case.

40371 (EPRI-CS—5167-Vol.1, pp 4.1-4.9) **Status of the acid rain debate.** McLean, B.J. (Environmental Protection Agency). May 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920421.

In Proceedings: tenth symposium on flue gas desulfurization: Volume 1.

The status of the acid rain debate is discussed. Acid rain is both an issue and a problem. The acid rain problem is characterized by deposition of acidic compounds which can damage aquatic systems and may be damaging forests and materials. Through research efforts, the extent of this damage, the mechanisms that cause it, and the prognosis for future damage are being assessed. The efforts to formulate a solution to the problem are discussed.

40372 (EPRI-CS—5167-Vol.1, pp 4.11-4.26) **Status of the National Acid Precipitation Assessment Program.** Irving, P.M. (National Acid Precipitation Assessment Program, Washington, DC). May 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920421.

In Proceedings: tenth symposium on flue gas desulfurization: Volume 1.

The Acid Precipitation Act of 1980 (Title VII of the Energy Security Act of 1980, Public Law 92-294) established the Interagency Task Force on Acid Precipitation to implement a national program to increase the understanding of the causes and effects of acidic deposition. The National Acid Precipitation Assessment Program (NAPAP) was thus established to manage research efforts to reduce uncertainties for policymakers in the assessment of acidic precipitation effects. The program includes research within six federal agencies and is grouped in seven categories: (1) emissions and controls, (2) atmospheric chemistry, (3) atmospheric transport and modeling, (4) air quality and deposition, (5) terrestrial effects, (6) aquatics effects, and (7) materials. The major research efforts of the Program include investigations to reduce the uncertainties associated with the relationship between emissions and deposition and the relationship between deposition and effects. Major areas of research include: comprehensive inventories of emissions, studies in atmospheric chemistry, atmospheric modeling, deposition and air quality monitoring and effects research on agricultural crops, plantation and natural forests, watersheds and materials.

40373 (EPRI-CS—5167-Vol.1, pp 5.1-5.25) **Review of proposed industrial boiler SO_2 NSPS: engineering analyses of FGD technology.** Pahl, D.A.; Sedman, C.B.; Aul, E.F. Jr. (Environmental Protection Agency, Research Triangle Park, NC). May 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920421.

In Proceedings: tenth symposium on flue gas desulfurization: Volume 1.

The US Environmental Protection Agency recently proposed new source performance standards (NSPS) to control air emissions of sulfur dioxide (SO_2) from new industrial boilers. The major provisions of these standards would require compliance with both a percent reduction requirement and an emission limit. Boilers subject to the standards would be required to reduce SO_2 emissions by 90%. Boilers firing coal would be required to meet an emissions limit of 1.2 lb $SO_2/10^6$ Btu of heat input; boilers firing oil would be required to meet a limit of 0.8 lb $SO_2/10^6$ Btu of heat input. A significant portion of the standard development process for this NSPS included engineering analyses of FGD systems. This paper reviews selected results of these analyses, including the performance, cost, and reliability of FGD systems and the secondary environmental impacts that may be associated with their use.

40374 (EPRI-CS—5167-Vol.1, pp 6.1-6.9) **Three years of organic acid use at San Miguel.** Cmiel, R.; Seeman, D. (San Miguel Electric Cooperative, Inc., Jourdanton, TX). May 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920421.

In Proceedings: tenth symposium on flue gas desulfurization: Volume 1.

The San Miguel scrubber results since commercial plant operation in 1982 are summarized. The organic acid mechanism has historically been called a buffer. It is believed that this mechanism can be more easily understood and accepted if presented as a mass transfer catalyst. Maintenance dollars continue to be spent on linings. The absorbers' natural rubber has blistered and organic acid has been detected in the extracted blister fluid. Work in progress is investigating possible betterments in linings, process chemistry, organic acid consumption and day to day procedures. The scrubber at San Miguel has been operated with organic acid since November, 1983. Average consumption is about 14 lbs. organic acid per ton sulfur dioxide. The actual to theoretical consumption ratio is about 7. The initial skepticism of a chemical fix in a traditional mechanical power plant is gone. In 1986, scrubber operation with organic acid continues as routine.

40375 (EPRI-CS—5167-Vol.1, pp 6.11-6.25) **Enhancement of wet limestone flue gas desulfurization by organic acid/salt additives.** Chang, J.C.S.; Brna, T.G. (Acurex Corp., Research Triangle Park, NC). May 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920421.

In Proceedings: tenth symposium on flue gas desulfurization: Volume 1.

Experimental data from recent pilot plant tests of organic acids/salts as additives to enhance the performance of wet limestone flue gas desulfurization processes are presented. The technical and economical feasibilities of five different organic acids and salts were assessed by comparing new data with previous data. Sodium formate appeared to be a promising alternative for natural oxidation when compared with adipic acid and dibasic acids. However, unsatisfactory solids dewatering properties were obtained with sodium formate in forced oxidation when the system pH was maintained above 5.35.

40376 (EPRI-CS—5167-Vol.1, pp 6.27-6.46) **Comparison of the effectiveness of FGD additives for SO_2 removal enhancement and additive consumption.** Jarvis, J.B.; Owens, D.R.; Stewart, D.A. May 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920421.

In Proceedings: tenth symposium on flue gas desulfurization: Volume 1.

The results of an FGD organic acid additive test program using EPRI's 5 cfm bench-scale FGD system are presented. The objective of the tests was to compare the effectiveness of organic additives with respect to SO_2 removal and additive consumption. Additives were selected which were either in commercial use, or which showed the potential for commercial use. The tested additives included adipic acid, a waste solid containing adipic acid, two waste streams containing a mixture of dibasic acids (DBA), a waste stream containing maleic acid, and formic acid. In addition, two components of DBA, glutaric and succinic acid, were also tested. Most of the tests were performed under natural oxidation conditions (30 to 40% oxidation) with limestone reagent. Two additional tests were performed with the DBA mixtures to evaluate the effect of forced oxidation and slurry temperature on additive consumption. Results are presented showing SO_2 removal as a function of additive concentration, and additive consumption as a function of acid type and the process variables tested. The consumption data includes measurements of both chemical degradation and solids coprecipitation or occlusion. Based on the test data, estimates of the DBA and adipic acid consumption rates for full-scale systems have been prepared. These estimates are compared to measured consumption data from four full-scale systems and two pilot systems.

40377 (EPRI-CS—5167-Vol.1, pp 6.47-6.61) **Thiosulfate additives for lime/limestone scrubbing.** Rochelle, G.T.; Lee, Y.J.; Ruiz-Alsop, R.N.; Chang, J.C.S.; Brna, T.G. (Univ. of Texas, Austin). May 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920421.

In Proceedings: tenth symposium on flue gas desulfurization: Volume 1.

Powdered sulfur, ammonium thiosulfate, and sodium polysulfide have been tested as alternatives to sodium thiosulfate for inhibiting sulfite oxidation in limestone slurry scrubbing. In bench-scale experiments, powdered sulfur reacted with calcium sulfite at rates adequate to permit in situ synthesis of thiosulfate. Use of powdered sulfur would be 15 to 25% the cost of sodium thiosulfate solution. In pilot plant tests, ammonium thiosulfate and sodium polysulfide were effective at 25 to 50% the cost of sodium thiosulfate, respectively. Methods must be developed to avoid odor caused by the release of hydrogen sulfide from sodium polysulfide.

40378 (EPRI-CS—5167-Vol.1, pp 7.1-7.5) **Integrated air pollution control system design and cost-estimating model (Version II).** Palmisano, P.J.; Laseke, B.A.; Kaplan, N. (PEI Associates, Inc., Cincinnati, OH). May 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920421.

In Proceedings: tenth symposium on flue gas desulfurization: Volume 1.

The Integrated Air Pollution Control System (IAPCS) is a computerized simulation model used to estimate the costs and predict the performance of sulfur dioxide, nitrogen oxides (NO/sub x/), and particulate matter emission control systems for coal-fired utility boilers. The model includes conventional and emerging technologies that effect pre-, in situ, and post-combustion emission control. It can accept any combination of the technology modules built into the system. Interactions are reflected in a material balance tabulation of emissions at the exit of each module. Alterations in the material balance are used to account for integrated performance and cost effects. The emission control technologies contained in IAPCS can be selected in isolated or integrated configurations. This IAPCS-II version was completed in April 1986. It incorporates several enhancements. Control module enhancements include upgrades to five modules: wet flue gas desulfurization, low-NO/sub x/ combustion, limestone injection multistage burner, electrostatic precipitator, and fabric filter. Other important enhancements include expanding the solid waste handling and disposal module, housing the model on a microcomputer (personal computer), providing EPRI and TVA economic premises, and expanding the user-activated parameter file.

40379 (EPRI-CS—5167-Vol.1, pp 7.7-7.12) **FGD cost-estimating computer model.** Keeth, R.J.; Ireland, P.A.; Van Winkle, K.S.; Moser, R.E. (Stearns Catalytic Corp.). May 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920421.

In Proceedings: tenth symposium on flue gas desulfurization: Volume 1.

Software has been developed to allow utility personnel to estimate FGD capital and operating costs for site specific conditions. It is currently available for use on IBM-compatible personal com-

puters in floppy disk or hard disk format. This computer program is based on the Retrofit FGD Cost Estimating Guidelines, EPRI CS-3696, published in October 1984. Utility testing of the model has been completed and it will shortly be ready for general distribution to the industry.

40380 (EPRI-CS—5167-Vol.1, pp 7.13-7.17) **Computer programs for FGD data management and operation.** Hebets, M.J.; Berry, C.A.; Donaldson, R.W.; Johnston, M.T.; Stewart, D.A. (Radian Corp., Austin, TX). May 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920421.

In Proceedings: tenth symposium on flue gas desulfurization: Volume 1.

Along with the management of equipment, raw materials, and operating personnel, the management of data is essential for efficient FGD operation. Data are required to evaluate and document the performance of the FGD system and for process improvements. Moreover, It is essential as the basis of any problem troubleshooting. A package of computer programs for managing FGD data developed under EPRI Research Project 1031-4 is described.

40381 (EPRI-CS—5167-Vol.1, pp 7.19-7.23) **Simulation of spray dryer absorber for removal of SO_2 from flue gases.** Maibodi, M.M.; Pearson, T.L.; Counce, R.M.; Davis, W.T. (Univ. of Tennessee, Knoxville). May 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920421.

In Proceedings: tenth symposium on flue gas desulfurization: Volume 1.

Removal of SO_2 from flue gases is important in air pollution control. The focus of the present activity is the development of a mechanistically-based mathematical model of SO_2 removal in a pilot-plant-scale spray dryer. In the spray dryer, flue gas fro a coal-fired boiler is contacted with an atomized lime slurry. During this contact SO_2 absorbs and reacts with dissolved calcium hydroxide. The mathematical model presented was developed by Maibodi and Pearson; this model superimposes SO_2 absorption and reaction phenomena on existing mathematical descriptions of spray-dryer operation. This work is part of an ongoing effort to improve the capability of predicting spray dryer performance. Using established spray-dryer terminology the SO_2 removal processes occur primarily in the constant-rate period. Efficiency predictions using the model presented were compared with pilot-plant data taken at different inlet flue gas temperatures, stoichiometric ratios, slurry flow rates and droplet sizes. This comparison shows good agreement of model predictions with the individual data points and with overall trends in the data.

40382 (EPRI-CS—5167-Vol.1, pp 7.25-7.28) **Interpretation of GADS data.** Weilert, C.V.; Hammontree, D.B.; Dyer, P.N. (Burns & McDonnell Engineering Co., Kansas City, MO). May 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920421.

In Proceedings: tenth symposium on flue gas desulfurization: Volume 1.

The collection and dissemination of operating and maintenance costs for flue gas desulfurization systems (FGD) has always been somewhat of a problem. This has been due to the lack of a comprehensive and easy to use system for data gathering and retrieval. The Generating Availability Data System (GADS) program as implemented by the North American Electric Reliability Council (NERC) has been a great help in reliving this situation. Utilities participating in this program have collected a great deal of data on their systems over the years. What has been missing for the most part is the ability of individual utilities to analyze these massive data files. In order to provide some on-site analysis capability, Burns & McDonnell has ported portions of their mainframe Gads Evaluation System (GES) to a microcomputer based analysis system. Some of the experience in using this software and the NERC GADS data as a diagnostic tool in FGD system evaluations and upgrades are discussed.

40383 (EPRI-CS—5167-Vol.1, pp 7.29-7.35) **Leaning brick stack liners.** Rosenberg, H.S.; Kistler, C.W.; Dille, E.R.; Moser, R.E. (Battelle Columbus Div., OH). May 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920421.

In Proceedings: tenth symposium on flue gas desulfurization: Volume 1.

Acid-resistant bricks have been used successfully for decades in hot, dry stacks. However, in some of the approximately 50 brick-lined stacks associated with wet FGD systems at electric utility plants in the US, a free-standing flue has been found to learn. Six stacks are reported to have significant leaning problems and several others to have a lesser degree of lean. Four of the stacks with significant leans have leaned in the direction of the scrubbed gas breeching. The other two have spiraled away from this breeching. As reported previously, the flues with significant leans [greater than 30 cm (12 in.)] are associated with FGD systems in which scrubbed gas and bypass gas are mixed in the stack, either for intentional reheat or during absorber module outages. Also, most of the flues with minor leans [less than 15 cm (6 in.)] are associated with FGD systems in which scrubbed gas and bypass gas are mixed in the ductwork upstream of the stack breeching. Because of the potential for a long, costly outage to repair a damaged stack, the leaning brick flue phenomenon has begun to recognized and receive research effort in an attempt to solve the problem. Two projects dealing with leaning stacks are discussed.

40384 (EPRI-CS—5167-Vol.1, pp 7.37-7.41) **100+ MW demonstration of dry sodium injection flue gas desulfurization.** Ablin, D.W.; Hammond, J.J.; Watts, D.B.; Ostop, R.L.; Hooper, R.G. (Colorado Springs Dept. of Utilities). May 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920421.

In Proceedings: tenth symposium on flue gas desulfurization: Volume 1.

A full-scale demonstration and test program of the injection of dry sodium sorbents upstream of a fabric filter for SO_2 removal is discussed. The program was conducted from November 1985 through April 1986 on the Unit 1 boiler at the R.D. Nixon power plant in Fountain, Colorado. This boiler is rated at 223 MW, fires low-sulfur western coal, and is equipped with two reverse-gas cleaned fabric filters, each designed to handle one-half the total flue gas flow. Sodium-based sorbents were injected upstream of one of the fabric filters thus providing a 100+ MW demonstration, side-by-side with an identical fabric filter operating without sorbent injection. The objective of the test program was to demonstrate the capability of dry injection FGD technology to reduce the sulfur dioxide emissions of a full scale utility boiler by 70% on a 30-day rolling average basis, and be economical in doing so. Test results are discussed.

40385 (EPRI-CS—5167-Vol.1, pp 7.43-7.49) **Operating experience of a retrofitted dry scrubber at an industrial steam plant.** Baldwin, R.; Buschmann, J.; Goffredi, R. (Rockwell International, Columbus, OH). May 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920421.

In Proceedings: tenth symposium on flue gas desulfurization: Volume 1.

A Flakt dry scrubber FGD system was retrofitted at an existing industrial steam plant operated by Rockwell International in Columbus, Ohio. The plant consists of four coal-fired boilers with a design capacity of 102,060 kg/hr (225,000 lb/hr) steam total. The coal burned in the plant typically contains 2.0-3.5% sulfur. The dry scrubber has been in operation since December 1985 and has achieved the anticipated sulfur dioxide removal efficiencies. Although some operating problems were experienced during early operation, the scrubber now runs relatively smoothly with a minimum of operator attention. The equipment design is reviewed and the startup and operating experience to date is summarized.

40386 (EPRI-CS—5167-Vol.1, pp 7.51-7.55) **Planning maintenance for flue gas desulfurization systems.** Davidson, L.N.; Miller, G.P.; Wedig, C.P.; Moser, R.E. (Stone & Webster Engineering Corp., Boston, MA). May 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920421.

In Proceedings: tenth symposium on flue gas desulfurization: Volume 1.

The size and complexity of a flue gas desulfurization (FGD) system require an effective maintenance program for reliable operation. In addition to keeping an FGD system online, an effective maintenance program can extend equipment life, improve equipment performance, increase system availability, reduce operating costs, and improve safety. In practice, benefits outweigh the costs of installing and operating a maintenance program. The recently completed FGD Maintenance Guidelines Project, which was funded by the Electric Power Research Institute (EPRI), provides direction in selecting and implementing maintenance programs. The utility industry's experience with FGD maintenance programs; a method for organizing and managing maintenance programs; designing for maintainability; and typical maintenance needs of different types of FGD systems are described. A generic approach to planning FGD maintenance programs that was developed for the Guidelines is summarized.

40387 (EPRI-CS—5167-Vol.1, pp 7.57-7.65) **SO_2/NO/sub x/ removal by $Ca(OH)_2$.** Chu, P.; Rochelle, G.T. (Univ. of Texas, Austin). May 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920421.

In Proceedings: tenth symposium on flue gas desulfurization: Volume 1.

Previous workers have shown that simultaneous SO_2/NO/sub x/ removal can be obtained in a dry scrubbing system with $Ca(OH)_2$ promoted by an additive such as NaOH, and that fly ash and product recycle improve the reactivity of the solids toward SO_2. To test SO_2/NO/sub x/ removal with fly ash product recycle, bench-scale experiments with a packed bed reactor were performed at bag filter conditions. The most reactive solid for NO/sub x/ removal was prepared by slurrying $Ca(OH)_2$ with fly ash, $CaSO_3$, and NaOH. The best conditions for NO/sub x/ removal were the greatest temperature (125°C) and greatest concentration of SO_2 (1500 ppm) and O_2 (20%). At the best conditions, NO/sub x/ removed in 1 hour was 3 to 4 moles per 100 moles $Ca(OH)_2$, compared to 5 to 10 moles SO_2 removed per 100 mols $Ca(OH)_2$. The best SO_2 removal was obtained at the highest relative humidities/lowest temperatures (55% RH/65°C) with solids prepared by slurrying $Ca(OH)_2$ with flyash and NaOH. At these conditions, SO_2 removed in 1 hour was 60 to 80 moles per 100 moles $Ca(OH)_2$, compared to 0.5 to 1 moles NO/sub x/ removed per 100 moles $Ca(OH)_2$.

40388 (EPRI-CS—5167-Vol.1, pp 7.67-7.71) **Combined SO_2/NO/sub x/ removal from flue gas by electron beam.** Helfritch, D.J. (Cottrell Environmental Sciences, Somerville, NJ). May 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920421.

In Proceedings: tenth symposium on flue gas desulfurization: Volume 1.

When a high energy beam of electrons is directed into flue gas, abundant quantities of radicals and free atoms are generated. The radicals and atoms containing oxygen react with SO_2 and NO/sub x/ to form acids. These acids can be removed by reaction with an alkali to form solid salts. These reactions are enhanced by high humidity, low temperature flue gas. A lime slurry spray dryer can be used in order to achieve these gas conditions and to supply the required alkali. In this method the flue gas first passes through a spray dryer, where the gas is cooled and humidified by means of slurry evaporation, and hydrated lime in the form of fine particulate is entrained by the gas. Approximately one-half of the SO_2 reacts with the calcium hydroxide in the spray dryer to form calcium sulfite. The gas is subsequently irradiated by an electron beam which results in the conversion of SO_2 and NO/sub x/ to sulfuric and nitric acid. The gas finally passes through a fabric filter in which the acids react with calcium hydroxide to produce calcium sulfate and nitrate. These products, as well as entrained fly ash are removed by the fabric filter. In order to evaluate this concept and to provide design guidelines for commercial scale applications, a pilot scale spray dryer, electron beam, fabric filter system was operated at the TVA Shawnee Steam Plant from February 1984 to February 1985. The objectives of the test program were to determine the relationships between SO_2/NO/sub x/ removal and electron beam energy, gas temperature, gas humidity, SO_2 concentration and lime usage, and to evaluate the economic viability of a commercial scale electron beam system.

40389 (EPRI-CS—5167-Vol.1, pp 7.73-7.78) **Removal of SO_2 and NO/sub x/ from stack gases by electron beam irradiation.** Ham, D.O.; Person, J.C. (Physical Sciences Inc., Andover, MA). May 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920421.

In Proceedings: tenth symposium on flue gas desulfurization: Volume 1.

The relative operating costs in terms of energy efficiencies for SO_2/NO/sub x/ removal from stack gases by advanced radiation concepts were evaluated. To meet this objective, critical technical evaluations were performed of each of the advanced, radiation-initiated concepts; excitation by e-beams, discharges or photons. To accomplish this, physically realistic models were incorporated into a computer code that was validated by comparison with existing data. The chemistry of SO_2/NO/sub x/ removal is discussed in terms of the simplest, physically realistic mechanism. This can only be accomplished with confidence by evaluating the importance of a large number of reactions by using a complex model incorporating all possibly important reactions to fit all available data. The chemical kinetics model of about 200 reactions was refined to obtain acceptable fits to the total available data base. All rate constants used must be compatible with accepted measured values. From calculations with this extensive model, it was determined which reactions affect concentrations of the important reacting species and thereby deduce a simple yet accurate representation of the chemical mechanism. Such a simple picture is essential for conceptual understanding and development of a useful intuition for these processes.

40390 (EPRI-CS—5167-Vol.1, pp 7.79-7.83) **Description and mechanism of limestone FGD operating problems due to aluminum/fluoride chemistry.** Jarvis, J.B.; Farmer, R.W.; Stewart, D.A. (Radian Corp., Austin, TX). May 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920421.

In Proceedings: tenth symposium on flue gas desulfurization: Volume 1.

Recent tests at EPRI's Arapahoe pilot facility have indicated that wet flue gas desulfurization (FGD) system operating problems may be experienced during periods of poor electrostatic precipitator (ESP) performance. These FGD operating problems, which include low operating pH and reduced SO_2 removal, are the result of inhibited limestone dissolution caused by the formation of soluble aluminum fluoride complexes. At Arapahoe, the formation of aluminum-fluoride complexes allowed an operating pH of only 5.1, even at limestone reagent ratios above 2.0. This phenomena was investigated, employing both bench-scale scrubber simulations, and limestone and fly ash dissolution experiments. Results of the test program are discussed.

40391 (EPRI-CS—5167-Vol.1, pp 7.85-7.91) **Enhancing double-alkali and lime/limestone flue-gas-desulfurization chemistries to promote NO/sub x/ removal.** Harkness, J.B.L.; Doctor, R.D.; Livengood, C.D. (Argonne National Lab., IL). May 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920421. Contract W-31-109-ENG-38.

In Proceedings: tenth symposium on flue gas desulfurization: Volume 1.

One approach to the simultaneous removal of nitrogen oxides (NO/sub x/) and sulfur oxides (SO/sub x/) from flue gases emitted by coal-fired boilers is the addition of an NO/sub x/-control additive to existing flue-gas-desulfurization (FGD) processes. This technique can be retrofitted to the existing 55 GW of scrubber capacity and offers greater simplicity and operability than systems that combine selective catalytic reduction (SCR) of NO/sub x/ in series with separate FGD processes. In spite of numerous research efforts in the US and abroad, commercialization of this NO/sub x/-control technique has been hindered by poor NO/sub x/ removals,

high reagent costs, and excessive additive losses. Significant progress in the development of NO/sub x/-control additives for conventional wet-scrubber chemistries has recently been made at Argonne National Laboratory (ANL). The development of these control additives is discussed.

40392 (EPRI-CS—5167-Vol.1, pp 7.93-7.97) **Review of methods for increasing limestone reagent fineness for flue gas desulfurization.** Seward, R.K.; Brame, K.A. (Kennedy Van Saun Corp., Danville, PA). May 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920421.

In Proceedings: tenth symposium on flue gas desulfurization: Volume 1.

Evolving technology in flue gas desulfurization (FGD) by wet limestone scrubbing has indicated that finer limestone slurry products might be needed to improve SO_2 removal efficiencies. For new FGD installations this is not a problem because the engineer can design limestone slurry preparation facilities to meet his needs. However, at existing FGD facilities where there is a need for a finer limestone product, the problem becomes acute. Process/operating modifications are presented which will maximize the fineness of the limestone slurry for an existing FGD unit. A review of limestone grinding system field data illustrates the effects on limestone product size of work index grindability, system feed rate, cyclone feed percent solids and other process variables. In addition, operating methods to maximize fineness are presented. Effects of classification on system efficiency and limestone product size are explained.

40393 (EPRI-CS—5167-Vol.1, pp 7.99-7.103) **FGD materials failure causes.** Ellis, P.F. II; Moser, R. (Radian Corp., Austin, TX). May 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920421.

In Proceedings: tenth symposium on flue gas desulfurization: Volume 1.

In 1982, Radian Corporation began an ongoing EPRI sponsored program, RP 2248-2, to investigate the causes of materials failures in FGD systems. This session presentation was designed to acquaint utilities with this program and to present a summary of results to date. This summary, though different in format from the poster presentation, is intended to provide a convenient take-home version of the poster session presentation.

40394 (EPRI-CS—5167-Vol.1, pp 7.105-7.109) **Shawnee 10-MW spray dryer/electrostatic precipitator pilot plant.** Runyan, R.A.; Barkley, J.B.; Patterson, J.G. Jr.; Henson, L.J.; Newton, S.F. (Tennessee Valley Authority, Chattanooga). May 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920421.

In Proceedings: tenth symposium on flue gas desulfurization: Volume 1.

Before the lime-based spray dryer/electrostatic precipitator (SD/ESP) dry flue gas desulfurization technology can be considered proven and thus available for use on utility boilers burning medium- to high-sulfur coal, data are needed from a larger utility-oriented pilot plant to confirm preliminary results obtained on the 1- to 2-MW spray dryer pilot plants at the Shawnee Steam Plant and to assess the process design, operation parameters, hardware requirements, and to determine the maximum reliable performance. Since TVA has a large number of existing fossil plants which rely on ESPs for particulate control, as do most eastern coal-fired plants, the assessment of the lime-based SD/ESP technology for retrofit applications is a high priority. Therefore, TVA has installed a 10-MW SD/ESP pilot plant at its Shawnee Steam Plant near Paducah, Kentucky, to further investigate this potential application. An overview of the system is presented and the test plan is discussed.

40395 **(PB—87-188926/XAB) Evaluation of innovative combustion technology for simultaneous control of SOx and NOx. Final report, October 1984-September 19Ɛ5.** Snow, G.C.; Lorrain, J.M. (Acurex Corp., Research Triangle Park, NC (USA). Southeast Regional Office). Apr 1987. 240p. (ACUREX/TR—86/010/SR). NTIS, PC A11/MF A01.

The report gives results of the operation of a 13.8-kW Limestone Injection Multistage Burner (LIMB) furnace. Furnace characterization, general sorbent survey, and calcium silicate test results are also given. Several candidate sorbent materials for the full-scale LIMB demonstration at Edgewater Station (Ohio) were evaluated. SO_2 capture was measured while firing Pittsburgh No. 8 coal (2.6% sulfur) and natural gas spiked with SO_2. Sorbent was injected at 1210 C. With a furnace quench rate of 260 C/s, the average residence time at reaction temperatures was 1.3 s. At Ca/S molar ratios of 2, Vicron 45-3 limestone reduced SO_2 emissions 38% from baseline levels. Increased SO_2 capture rates of 60-69% were measured for various calcitic atmospheric hydrates. Dolomitic sorbents were able to achieve captures of 73-75% and showed no significant difference between atmospheric and pressure hydrates. With the addition of sodium bicarbonate at molar Ca/Na = 15, captures of 83 and 88% were possible for the calcitic and dolomitic hydrates, respectively. Sodium bicarbonate was evaluated as a fuel additive as well as a sorbent additive.

40396 **(PB—87-190948/XAB) Contribution to coal-dust characterization by microsieve and image analysis.** Korwin-Kossakowski, L.E.; Brandt, M.P. (National Inst. for Coal Research, Pretoria (South Africa)). 1986. 20p. (COAL—8601). NTIS, PC PC E04/MF E04.

A combination of microsieve analysis and image analysis/optical microscopy for coal dust characterization has been investigated and a study has been made of the influence of the instrumental and experimental parameters on the results. Attention is also drawn to the methods of sample preparation. The results of three coal-dust samples are reported and include size distribution, sieve and image analyzer-derived equivalent diameters, perimeter (fractured surface) of particles, length and width of particles and shape factors.

40397 **Concentration of synfuel process condensates by reverse osmosis.** McCray, S.B.; Ray, R.J. (Bend Research, Inc., OR). *Separation Science and Technology;* **22**: No. 2/3, 745-762(1987). (CONF-851011—).

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

In this paper the authors will discuss the use of a novel, fouling-resistant, inside-skinned hollow-fiber membrane configuration as an energy-efficient and cost-effective alternative to conventional treatment of synfuel process condensate waters. Reverse osmosis has been used in the past only to polish condensate waters that were first treated by conventional means. In the work described in this paper, a reverse-osmosis system actually replaces traditional biotreatment of condensate waters or replaces the solvent-extraction process in the treatment train. The membranes used in this reverse-osmosis system are capable of rejecting at least 90% of the phenols as well as high percentages of other organics contained in actual process condensate waters. Furthermore, these membranes have operated for several months on synfuel condensate waters and showed no significant decrease in performance. Energy and cost estimates of a reverse-osmosis system based on such membranes will be discussed in detail, including a comparison of operating costs of this system with the operating costs of conventional treatment systems.

0109 Environmental Aspects

REFER ALSO TO CITATION(S) 40325, 41946, 42261

0110 Reserves And Exploration

40398 (SAND—86-1514-Vol.11-No.-1, pp 2-17) **Fossil energy.** Apr 1987. NTIS, PC A04/MF A01. File Number DE87009977.

In Sandia technology: Volume 11, No. 1.

Fossil fuels, the country's most abundant resource, are expected to supply the greater part of the nation's heat, fuel, and electricity until well into the 21st century. US coal reserves, for instance, are estimated to be sufficient for 400 years. Oil and gas reserves, on the other hand, have declined steadily since 1970, indicating that national reserves in 2020 could be as low as 25% of the present level. Research and development work in all areas of fossil energy - coal, oil, and gas is discussed. In the case of coal, experi-

ments with new pretreatment techniques, advanced conversion methods based on new and improved catalysts, and advanced combustion technology, all of which will be needed to achieve environmentally acceptable, efficiently transportable energy forms are discussed. For oil and gas extraction, new technologies that will enable industry to obtain more of these resources from known reserves and to tap less accessible deposits at affordable costs are being developed.

0120 Mining

REFER ALSO TO CITATION(S) 40414

40399 **(NP—7770237) Methods for early detection of small-scale tectonic faults in coal seams.** Makrutzki, V. (Technische Hochschule Aachen (Germany, F.R.). Fakultaet fuer Bergbau und Huettenwesen). 1 Jul 1985. 127p. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE87770237.

The author intends to make a contribution to the detection of small-scale tectonic faults prior to mining activities. For this purpose, he investigates the geological and rock-mechanical parameters of the bedrock as well as in-face convergence measurements. Among the geological parameters investigated are the seam dip, the thickness of coal and bedrock strata, the strike of the cleavage, the spacing of cleavages, and the strike and dip of the faults. The rock-mechanical parameters are the roof structure, the caving of the roof, and the fracture phenomena during caving.

40400 **(NP—7770240) Systematic simulation of earth-leakage faults in earthed cable systems of German coal mines.** Woltemate, R. (Dortmund Univ. (Germany, F.R.). Abt. Elektrotechnik). 1 Jul 1985. 124p. (In German). NTIS (US Sales Only), PC A06. File Number DE87770240.

The relevant methods for calculation and simulation of earth-leakage faults in resonant earthed cable systems of coal mines are discussed and applied to critical cases for selective earth-fault recovery. By designed networks, choice of suitable equipment and its proper setting, earth-leakage faults are cut off selective and reliable. Automatic monitoring of networks guarantees that the protection system always is adapted to the changing networks.

40401 **(PB—87-188710/XAB) Deserado Mine computerized monitoring and control system evaluation. Open file report.** Eros, L.A.; King, R.H. (Colorado School of Mines, Golden (USA). Dept. of Mining Engineering). Jun 1986. 119p. NTIS, PC A06/MF A01.

The report describes the planning, installation, and evaluation of a microcomputer-based monitoring and control system at the Deserado Mine, an underground coal mine. Costs, benefits, problems, and management and labor perceptions are included, and recommendations are provided for mine operators and monitoring system vendors considering future installations.

40402 **(PB—87-188736/XAB) Conceptual investigation of a management information system for underground coal mines. Open file report.** Kohler, J.L.; Ramani, R.V.; Koharchik, G.; Bhaskar, R. (Pennsylvania State Univ., University Park (USA). Dept. of Mineral Engineering). Dec 1986. 192p. NTIS, PC A09/MF A01.

The final report presents the results of an investigation into the development of a Management Information System (MIS) for underground coal mines. The intent of the project was to examine the information issues, various design aspects, and associated application concerns of an integrated monitoring MIS, such as the impact of this technology on safety. The work performed on the contract used mine ventilation as a prototypical example and concludes that a KBES formulation of an integrated monitoring MIS for coal-mine management is feasible and desirable. The report is presented in five chapters and six appendices and describes ventilation MIS system requirements, the formulation of a knowledge-based expert system (KBES) structure to implement the integrated ventilation monitoring MIS system, and the health and safety implications of the system.

40403 **Rockburst monitoring at the Sunshine Mine, Kellogg, Idaho.** Eeckhout, E.V.; Jordan, J.; Hollis, J.; Hartmann, M. (Los Alamos National Lab). pp 657-667 of Application of computers and operations research in the mineral industry. Ramani, R.V. Littleton, CO; Society of Mining Engineers of AIME (1986). (CONF-860473—).

From 19. international symposium on computer applications in the mineral industries; University Park, PA, USA (14 Apr 1986).

The rockburst monitoring system at the Sunshine Mine has recently been improved to increase the certainty of burst locations and to output location results in a manner amenable to easy interpretation. Three methods of location calculation were used: a computer code provided with the hardware in-place (the MP-250), a code based on the least-squares method, and a nonlinear iterative code written by the principal author. The more accurate locations are given by the latter two codes, but still are only correct to within about 100 ft. This error is due to uncertainties introduced by the geologic and mining variations versus the assumptions made in the location codes.

0140 Combustion

REFER ALSO TO CITATION(S) 40352, 40353, 40781

40404 **(DOE/MC/21353—2373) The particle-particle drag term in a multiparticle model of fluidization.** Syamlal, M. (EG and G/Washington Analytical Services Center, Inc., Morgantown, WV (USA)). May 1987. Contract AC21-85MC21353. 25p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006500.

The multiparticle model being developed at the US Department of Energy's Morgantown Energy Technology Center simulates fluidization phenomena such as segregation, elutriation, and solids mixing by describing the different types of solid particles as distinct particulate phases. To account for the momentum transfer between the particulate phases due to collisions, the model requires constitutive relations known as particle-particle drag terms. In dilute systems, such as pneumatic conveyors, the particle-particle drag has been measured and empirical correlations have been developed. But similar measurements are not possible in dense systems, such as fluidized beds. Hence, an expression for the particle-particle drag term was derived based on the kinetic theory of dense gases. To test the accuracy of that expression, the predictions of the model were compared to experimental data. Yang and Keairns (1982) fluidized uniform mixtures of dolomite and acrylic particles for various times and measured the rate of separation of the dolomite particles. The dolomite particles, being heavier and larger than the acrylic particles, were found to settle rapidly. The experimental data suggest that the rate of settling is strongly dependent upon the particle-particle drag and, hence, the simulation of these experiments is useful for determining the accuracy of the particle-particle drag term. Computer simulations have shown that the model predicts the initial rate of separation reasonably well. The predicted equilibrium concentrations of dolomite particles in the upper layer of acrylic particles, however, do not agree with the experimental data. This is thought to be because of the absence of granular stress from the model. Further refinement of the particle-particle drag term will be sought only after including granular stress in the model. 17 refs.

40405 **(DOE/PC/80752—T8) Detailed model for practical pulverized coal furnaces and gasifiers: Second annual progress report for the period 1 May 1986 to 30 April 1987.** Smith, P.J.; Smoot, L.D. (Brigham Young Univ., Provo, UT (USA). Combustion Lab.). 31 May 1987. Contract FG22-85PC80752. 121p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87011043.

On May 1, 1985, work was initiated on a contract sponsored by a consortium of industrial and government agencies aimed at development of a practical, 3-D coal combustion model for utility and industrial furnaces and gasifiers. This report summarizes work conducted over the second year of this contract by task and includes only tasks worked on during this period. Emphasis was directed toward development of the fluid mechanics of the three-dimensional model, in the absence of particulates and reactions (GAS3D).

This model element was coded, debugged and demonstrated for rectangular coordinates, and nearly completed for cylindrical coordinates. Solutions with GAS3D for limiting cases matched available two-dimensional solutions. A significant effort was made to identify and implement more efficient numerical methods for the three-dimensional code. Several differential equation solvers available in a standard format (ELLPACK) were reviewed and plans were made to evaluate these methods through computational comparisons. Further, multigridding strategies, which were reviewed and evaluated under separate funding, show significant promise for application to the 3-D code. Work to improve the robustness of the 2-D code (PCGC-2) when using the energy equation was nearly completed. Coal gasification and combustion solutions with PCGC-2 with the energy equation option were demonstrated. 131 refs., 39 figs., 6 tabs.

40406 **(DOE/PC/90962—T3) Experiments on densely-loaded non-Newtonian slurries in laminar and turbulent pipe flows: Quarterly technical progress report No. 3.** Park, J.T.; Mannheimer, R.J.; Grimley, T.A.; Morrow, T.B. (Southwest Research Inst., San Antonio, TX (USA)). 30 Jul 1987. Contract FG22-86PC90962. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012691.

An experimental evaluation of the structure of non-Newtonian slurries in laminar, transitional, and turbulent flow regimes in pipes is the primary objective of this research. Experiments are being conducted in a large-scale pipe slurry flow facility with an inside pipe diameter of 51 mm (2 inches). Data from rheological experiments will be correlated with pipe flow measurements. Detailed flow measurements including turbulence quantities such as Reynolds stress will be taken with a two-component laser-Doppler velocimeter (LDV) in a transparent test section with a transparent model slurry. During the past quarter, a benchmark experiment with mean-velocity and pressure-drop measurements was completed in the slurry loop with a glycerine and water mixture for the laminar and transitional flow regimes. The pipe friction factor from Hagen-Poiseuille theory was reproduced within experimental error for laminar flow conditions. The transition Reynolds number was 2000. The slurry loop was recently disassembled for corrosion treatment. Some parts are being replaced with PVC plastic parts, and the remainder of the carbon-steel components have been sand-blasted and epoxy painted. After the loop is reassembled in mid-August 1987, LDV measurements and flow visualization will commence. 5 refs., 3 figs.

40407 **(EPRI-CS—5186) Proceedings: 1986 seminar on atmospheric fluidized-bed combustion technology for utility applications.** Estey, P. (Science Applications International Corp., Los Altos, CA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jul 1987. 726p. (CONF-8604340—). Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920515.

From Seminar on atmospheric fluidized-bed combustion technology for utility applications; Palo Alto, CA, USA (8 Apr 1986).

This EPRI-sponsored seminar was organized to review recent technical and market developments related to utility-size AFBC steam generators. The objective of the seminar was to assist electric utilities in planning, evaluating, building, and operating AFBC power plants. Attendees included 231 representatives from 112 organizations (electric utilities, equipment vendors, architect/engineering companies, universities, and various government organizations). The major topics discussed during the seminar were operating experience from industrial AFBC units and Pilot Plants; progress on the three AFBC demonstration and other commercial projects; review of fuel characterization research as related to steam generator design; AFBC power plant simulation and controls; and issues related to economic assessments and power plant licensing. Papers have been entered individually into ERA and EDB.

40408 (INIS-mf—10706, pp 1-27) **Design aspects for large boilers for the combustion of Yugoslav coal: Features and operating experience.** Buzina, M.; Salem, A. (Sulzer Bros. Ltd., Winterthur, Switzerland). 1986. (In German). NTIS (US Sales Only), PC A16/MF A01. File Number DE87752788. (CONF-8605275—).

From VGB special meeting on Yugoslavia; Bled, Yugoslavia (14 May 1986).

The authors examine the correlations between coal grades and boiler system design. Pertinent coal and ash properties are studied including grindability, ash behaviour and parameters for fouling and slag formation. A number of large boiler systems in Yugoslav power plants are used to exemplify aspects determining the selection and design of individual boiler types and plant systems while reporting, in detail, on boiler systems using lignite, grinding and firing facilities, combustion chambers, bundle-type heating surfaces and evaporator systems. (HAG).

40409 (INIS-mf—10706, pp 1-15) **Problems with the combustion of low-grade coals in Yugoslavia.** Gruden, M. 1986. (In German). NTIS (US Sales Only), PC A16/MF A01. File Number DE87752788. (CONF-8605275—).

From VGB special meeting on Yugoslavia; Bled, Yugoslavia (14 May 1986).

The basic difficulties of firing Yugoslav, especially Slovene, coals are described. An estimate of the coal resources in SR Slovenia is given, with the basic qualities of the new mining fields in comparison with the already operating ones. Some results of this research on mechanics of slagging are presented as a basis for proper conception of new units.

40410 (INIS-mf—10706, pp 1-19) **Fouling problems with the combustion of Yugoslav coal.** Afgan, N.; Jovanovic, L. (Institut za Nuklearne Nauke Boris Kidric, Belgrade, Yugoslavia). 1986. (In German). NTIS (US Sales Only), PC A16/MF A01. File Number DE87752788. (CONF-8605275—).

From VGB special meeting on Yugoslavia; Bled, Yugoslavia (14 May 1986).

The different coal grade qualitites supplied by the collieries to the thermal power plants present a major problem for boiler design. Experience gained with the boiler design specifically laid out for a single grade of Yugoslav coal cannot be applied to other grades wholesale. The author analyses the tendency of Yugoslav coal types to produce fouling and slagging by deposition of solid matter. Coal analyses, as well as examinations of and experience with existing boilers allowed to define general criteria and to suggest designs and selection of boilers for Yugoslav coal grades which may be valuable guidelines for the analysis of boiler operation by thermal power plant staff.

40411 (INIS-mf—10706, pp 1-23) **Slagging and fouling: Origination mechanisms, influencing factors, abatement techniques.** Zelkowski, J. 1986. (In German). NTIS (US Sales Only), PC A16/MF A01. File Number DE87752788. (CONF-8605275—).

From VGB special meeting on Yugoslavia; Bled, Yugoslavia (14 May 1986).

The author deals with the deposits of ash and specific ash components on combustion chamber walls obtained in coal firing, while focussing on thermal and mechanical (rheological) causes of slagging and fouling. The author studies deposit formation, temperature level of slagging onset, critical flow velocities and the slaggability of coal types. A test system for studying slagging intensity is presented. The slagging behaviour of coal mixtures is explained and various abatement techniques like additives, flame temperature quenching, flue-gas recirculation, etc. are discussed. (HAG).

40412 **Numerical simulation of particle size distribution evolution during pulverized coal combustion.** Dunn-Rankin, D.; Kerstein, A.R. (Combustion Research Facility, Sandia National Labs., Livermore, CA 94550). *Combustion and Flame;* **69**: No. 2, 193-210(Aug 1987).

Two numerical simulations of particle size distribution (PSD) evolution during ash-free char combustion are presented to help determine the sensitivity of measured coal PSD evolution to fragmentation. The first simulation is based on percolation theory, and it builds the PSD evolution from an ensemble of individual particle size time histories. The second simulation is a population balance that operates on the entire distribution as a unit. Inputs to the simulations come from experimental data available in the literature, and results of the simulations are discussed in conjunction with these data.

40413 **Numerical simulation of particle size distribution evolution during pulverized coal combustion.** Dunn-Rankin, D.; Kerstein, A.R. Northridge, CA; Combustion Institute (1986). 22p. (CONF-8610180—). Combustion Institute, Western States Sect., c/o L.S. Caretto, Calif. State Univ., Northridge, CA 91330.

From Fall meeting of the Western States Section/Combustion Institute; Tucson, AZ, USA (27 Oct 1986).

Technical Paper WSS/CI 86-10.

The author presents two numerical simulations of particle size distribution (PSD) evolution during ash-free char combustion to help determine the sensitivity of measured coal PSD evolution to fragmentation. The first simulation is based on percolation theory, and it builds the PSD evolution from an ensemble of individual particle-size time histories. The second simulation is a population balance that operates on the entire distribution as a unit. Inputs to the simulations come from experimental data available in the literature, and results of the simulations are discussed in conjunction with these data.

0150 Marketing And Economics

40414 **(DOE/EIA—0121(87/1Q)) Quarterly coal report, January-March 1987.** (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). 21 Jul 1987. 137p. NTIS, PC A07/MF A01 - GPO; 1; GPO Dep. File Number DE87012956.

Coal production totaled 221.7 million short tons in January through March 1987, a 3.3% decrease from the record high level of first quarter 1986. Coal consumption was also down 3.3% from the same quarter a year ago. Also during January through March 1987: Stocks totaled 209.7 million short tons, an increase of 2.6% over the first quarter 1986. Coal receipts declined 6.5% from the previous quarter, but only 2.9% from the period January through March 1986. Coal exports totaled 16.6 million short tons, down from 17.2 million short tons in the first quarter of 1986. Coal imports declined 31.9% from the first quarter 1986. Coal production in the first quarter of 1987 was 4.8 million short tons or 2.2% more than the previous quarter and 7.6 million short tons or 3.3 percent less than in the same quarter a year earlier. Production was lower in the Appalachian Region (by 3.9 million short tons of 3.5%), the Interior Region (by 0.5 million short tons or 0.9%) and in the Western Region (by 3.3 million short tons or 4.8%). Total US coal consumption was 199.5 million short tons in the first quarter of 1987, 6.9 million short tons less than the record first quarter of a year earlier. During the period January through March 1987, electric utilities used 170.8 million short tons compared with 173.0 million short tons in the same period a year earlier, while coke plants used 7.8 million short tons compared with 10.4 million short tons for the same periods, respectively. 13 figs., 68 tabs.

40415 **(PB—87-183638/XAB) Assessment of technological development strategies for San Juan Basin coals. Technical report (Final), 8 May 1986-28 February 1987.** (Sinor (J.E.) Consultants, Inc., Niwot, CO (USA)). Feb 1987. 702p. NTIS, PC A99/MF E04.

An analysis of potential future markets for San Juan Basin coal and coal products covered coal, beneficiated coal, synthetic fuels from coal, and mineral products from coal ash. A transportation analysis was also completed, and used to calculate netback product values at a plant site in the San Juan basin. An economic screening analysis was carried out for processes identified as having economic potential. The best of these were then subjected to economic risk analysis. An overall development strategy was constructed with short-term, mid-term and long-term components. Approximate costs and benefits to the State of New Mexico were estimated for each of the recommended projects.

0160 Health And Safety

REFER ALSO TO CITATION(S) 40402, 42282

40416 **(NP—7770242) Relationship between pneumoconiosis, type and length of underground activity, amount and chemical composition of dusts in the lungs of deceased coal miners in the Ruhrgebiet.** Volf, T. (Technische Hochschule Aachen (Germany, F.R.). Medizinische Fakultaet). 24 May 1984. 83p. (In German). NTIS (US Sales Only), PC A05. File Number DE87770242.

The lung dust which was extracted by formamid cleavage from the lungs of 52 dead miners from the Ruhr mines was tested for SiO/sub 2/, Al/sub 2/O/sub 3/, lead, cadmium and zinc content. The relationships to anamnestic data as well as histologically diagnosed degree of silicosis were checked and the results were compared to those of other works done on the harmfulness of dust particles in mines. The consideration of the duration of time spent in the mine, without considering the varying incidents of pneumoconiosis at the mines as well as the varying intensity of dust loads, resulted in no connection with the measurement parameters. After all these factors were considered, then a positive correlation could be found between lung dust weight, SiO/sub 2/ concentration and Al/sub 2/O/sub 3/ concentration in the lungs. With extended absence from the mine the lung dust weight and the SiO/sub 2/ content of the lungs decreased. With increasing degrees of silicosis, the concentration of free SiO/sub 2/ in the dry lung tissue increased significantly, but not the total lung dust mass. The bronchial lymph nodes in any case could not be investigated at this time. For future postmortem analyses of lung dust, it is recommended to determine the penetration of dust in these lymph nodes. The lead and cadmium in the lung dust could be based on exogenous environmental pollution.

40417 (PNL—6100-Pt.1, pp 65-69) **Teratology of complex mixtures.** Mast, T.J. Feb 1987. NTIS, PC A06/MF A01. File Number DE87010024.

In Pacific Northwest Laboratory: annual report for 1986 to the DOE Office of Energy Research: Part 1, Biomedical Sciences.

The dermal exposure of pregnant rats to SRC-II heavy distillate results in a highly significant incidence of fetal abnormalities. Exposure to four different chemical class fractions of this mixture indicated that nearly 100% of the activity lay in the polycyclic aromatic hydrocarbon fraction. 1 figure, 7 tables.

40418 (PNL—6100-Pt.1, pp 75-77) **Tissue dose in complex mixture exposures.** Weimer, W.C. Feb 1987. NTIS, PC A06/MF A01. File Number DE87010024.

In Pacific Northwest Laboratory: annual report for 1986 to the DOE Office of Energy Research: Part 1, Biomedical Sciences.

The disposition of several complex mixture components in experimental animals has been studied as a function of several variables. The presence of the complex mixture was found to reduce the rate of removal of individual compounds from the blood, to decrease the rate of exhalation of these compounds, and to reduce the breath/blood partition coefficients for these compounds. The complex mixture did not alter the distribution of components within the animal. Experiments were performed using either a simple mixture of four polycyclic aromatic hydrocarbons (PAH; benzene, toluene, naphthalene, and phenanthrene) or a complex material composed of the PAH mixture and a mid-boiling-range coal liquid. 1 figure, 5 tables.

0170 Legislation And Regulations

40419 **Amend Section 402 of the Surface Mining Control and Reclamation Act of 1977. Hearing before the Subcommittee on Mineral Resources Development and Production of the Committee on Energy and Natural Resources, United States Senate, One Hundredth Congress, First Session on S. 643, March 31, 1987.** Washington, DC; Government Printing Office (1987). 30p.

Jed D. Christensen of the Office of Surface Mining Reclamation and Enforcement, Department of the Interior, was the princi-

pal witness at a hearing on S. 643, which amends the Surface Mining Control and Reclamation Act of 1977. The amendment would allow states to set aside as much as 10% from the reclamation trust fund to apply to abandoned sites. Senators speaking in favor of the bill reported problems with obtaining home loans and insurance due to subsidence from abandoned sites. Christensen supported the bill in principle, but noted possible problems with handling interest and the actual transfer of the money. He also noted a possible breakdown in regulation with the current wording of the bill. Additional material submitted for the record from representatives and officials of the State of Wyoming follows the text of S. 643 and the testimony of the five witnesses.

02 PETROLEUM

0202 Geology And Exploration

REFER ALSO TO CITATION(S) 40398, 40442, 40443, 40444, 40447, 40449, 40450, 40452

40420 **(PB—87-189239/XAB) Alaska OCS (Outer Continental Shelf) socio-economic studies program. Technical Report Number 114. Monitoring OCS activity in the Bering Sea. Final technical report.** Burden, P.L.; Feldman, M.L.; Barloon, K.L. (Burden (Patrick) and Associates, Anchorage, AK (USA)). Jun 1985. 214p. NTIS, PC A10/MF A01.

The study describes the information obtained by contacting over seventy firms that were active in Bering Sea exploration as either lease operators or service contractors for the 1980 through 1984 period. Pre-lease exploration activities included regional marine seismic surveys, high-resolution geophysical surveys, geological surveys, airborne geophysical surveys, and the installation and operation of navigation systems. Drilling activities included drilling-vessel operations, marine and air-support services and bases, lease-operator supervision, and the services provided by numerous specialized contractors such as mud loggers and divers. Employment and expenditure data were obtained for all pre-lease and post-lease exploratory drilling activities. Almost 4000 person years of employment were required, approximately 510 person years were to Alaska residents.

40421 **(PB—87-192829/XAB) Final environmental impact statement, proposed Outer Continental Shelf oil and gas lease sale, North Aleutian Basin, Sale 92. Volume 1.** Boyd, T.H.; Yankus, G. (Minerals Management Service, Anchorage, AK (USA). Alaska Outer Continental Shelf Region). Sep 1985. 565p. (MMS/AK/EIS—85/003). NTIS, PC A24/MF A01.

See also Volume 2, PB—87-192837, and PB—84-209428.

The EIS analyzes a proposed oil and gas lease sale in the North Aleutian Basin, alternatives to the proposal, major issues determined through the scoping process, and potential mitigating measures. The proposal consists of 990 blocks (approx. 2.27 million hectares) to be offered for lease in the North Aleutian Basin. The potential effects of the proposal are based, in part, on the assumption that mean resource estimates of 364 MMbbls of oil and 2.62 TCF of gas would be discovered and produced in the North Aleutian Basin.

40422 **(PB—87-192837/XAB) Final environmental impact statement, proposed Outer Continental Shelf oil and gas lease sale, North Aleutian Basin, Sale 92. Volume 2.** Boyd, T.H.; Yankus, G. (Minerals Management Service, Anchorage, AK (USA). Alaska Outer Continental Shelf Region). Sep 1985. 624p. (MMS/AK/EIS—85/004). NTIS, PC A99/MF A01.

See also Volume 1, PB—87-192829.

The EIS analyzes a proposed oil and gas lease sale in the North Aleutian Basin, alternatives to the proposal, major issues determined through the scoping process, and potential mitigating measures. The report, volume II contains the review and analysis of comments and appendices.

40423 **(PB—87-192845/XAB) Final environmental impact statement, proposed Outer Continental Shelf oil and gas lease sale, St. George Basin, Sale 89. Volume 1.** Hendrix, N.; Boyd, T. (Minerals Management Service, Anchorage, AK (USA). Alaska Outer Continental Shelf Region). Apr 1985. 581p. (MMS/AK/EIS—85/001). NTIS, PC A25/MF A01.

See also Volume 2, PB—87-192852, and DE84-900206.

The Environmental Impact Statement (EIS) analyzes a proposed oil and gas lease sale in St. George Basin, alternatives to the proposal, major issues determined through the scoping process, and potential mitigating measures. The proposal consists of 12,529 blocks to be offered for lease in the St. George Basin. The potential effects of the proposal are based, in part, on the assumption that mean resource estimates of 1125 Mbbls of oil and 9200 BCF of gas would be discovered and produced in the St. George Basin. The marginal probability of a commercial discovery of hydrocarbons is 22%. For this amount of oil, 3 oil spills of 1000 barrels or greater are projected statistically over the 25-year production life of the oil field.

40424 **(PB—87-192852/XAB) Final environmental impact statement, proposed Outer Continental Shelf oil and gas lease sale, St. George Basin, Sale 89. Volume 2.** Hendrix, N.; Boyd, T. (Minerals Management Service, Anchorage, AK (USA). Alaska Outer Continental Shelf Region). Apr 1985. 231p. (MMS/AK/EIS—85/002). NTIS, PC A11/MF A01.

See also Volume 1, PB—87-192845.

The Environmental Impact Statement analyzes a proposed oil and gas lease sale in St. George Basin, alternatives to the proposal, major issues determined through the scoping process, and potential mitigating measures. The proposal consists of 12,529 blocks to be offered for lease in the St. George Basin. The potential effects of this proposal are based, in part, on the assumption that mean resource estimates of 1125 Mbbls of oil and 9200 BCF of gas would be discovered and produced in the St. George Basin. For this amount of oil, 3 oil spills of 1,000 barrels or greater are projected statistically over the 25-year production life of the oil field. The volume contains the appendices.

40425 **(PB—87-193405/XAB) Diapir Field lease offering, June 1984. Volume 2. Appendices.** (Minerals Management Service, Anchorage, AK (USA). Alaska Outer Continental Shelf Region). Mar 1984. 213p. (MMS/AK/EIS—84/02). NTIS, PC A10/MF A01.

See also DE83-910818.

The Final Environmental Impact Statement discusses a proposal for oil and gas leasing in the Beaufort and Chukchi Seas, alternatives to the proposal, major issues determined through the scoping process and through staff analysis, and potential mitigating measures. The proposal consists of 3193 blocks (6,977,317 hectares) to be offered for lease 5 to 257 kilometers offshore in water depths of 2 to greater than 200 meters. The potential effects of the proposal are based in part on the assumption that the mean economically recoverable resources in the area are estimated to be 3.0 billion barrels of oil and 7.75 trillion cubic feet of gas. It is estimated that up to seven oil spills of 1000 barrels or greater may occur over the 40-year life of the oil field.

40426 **Liquid sampling system.** Larson, L.L. (to Dept. of Energy, Washington, DC). US Patent 4,674,343. 23 Jun 1987. Filed date 7 Sep 1984. vp.

This patent describes a fluid-operated apparatus for withdrawing a sample of liquid from a reservoir comprising: a withdrawal conduit in fluid communication with reservoir; fluid-operated pump; sample collection means including a vessel disposable in fluid communication with withdrawal conduit upstream of the pump means; pump means reducing the pressure in conduit for evacuating gas and sample collection vessel for inducing liquid flow through the conduit from the reservoir; and fluid-operated means responsive to the arrival of liquid from the reservoir for raising the pressure for causing liquid to flow into the vessel.

0203 Drilling And Production

REFER ALSO TO CITATION(S) 40326, 42307

40427 (DOE/IG—0241) Production accounting and controls at the Naval Petroleum Reserve No. 1, Elk Hills, California. (USDOE Office of Inspector General, Albuquerque, NM. Office of Audits). 17 Jul 1987. 18p. H. File Number TI87012990.

Report to The Secretary.

Purpose of the audit was to determine if the Reserve's crude oil and gas products were properly accounted for and controlled from well-head to ultimate use or sale and physical controls and security measures at the Reserve were sufficient to ensure that Government assets were safeguarded as required. Our review showed that the Reserve used sales rather than actual production as the basis for its production accounting process. This method of accounting gave the Reserve only an approximation of the oil and gas it produced. Security measures had been significantly improved since the Reserve was opened; however, there were certain well and tank site areas which were not adequately secured and safeguarded against loss. During the course of the audit, management took prompt action to enhance security procedures.

40428 (DOE/SF/11564—25) SUPRI heavy oil research program: Tenth annual report for the period October 1, 1985-December 31, 1986. Brigham, W.E.; Castanier, L.M. (Stanford Univ., CA (USA). Petroleum Research Inst.). Aug 1987. Contract AC03-81SF11564. 137p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87001255.

Accomplishments are presented for the following five tasks: (1) flow properties study; (2) in-situ combustion; (3) steam injection with additives; (4) reservoir definition; and (5) field support services. Separate abstracts have been prepared for each task. (AT)

40429 (LBL—22151, pp 1.27-1.30) Energy-related organic compounds: a microcomputer data base of chemical properties, structures, and synonyms (CPSS). Daughton, C.G.; Langlois, G.W.; Thomas, J.F. Mar 1987. NTIS, PC A02/MF A01. File Number DE87009270. Contract AC03-76SF00098.

In Energy Conversion and Storage Program: FY 1986, Annual report.

Countless organic compounds representing numerous chemical classes occur in the process streams from synthetic fuel or enhanced oil recovery (EOR) operations. Chemical characterization studies of these complex, heterogeneous samples have been conducted since the mid 1800s resulting in the accumulation of a wealth of uncompiled and unexamined data. In general, similar suites of chemical classes probably occur in process streams from different fuel production technologies. Most differences in composition are a reflection of different absolute and relative concentrations of these classes rather than the presence or absence of particular classes. A major long-term goal of this project is to establish a microcomputer data base that thoroughly categorizes each organic compound that has been identified in process streams or disposal sites for synfuel or enhanced-oil-recovery operations.

40430 (NIPER—127) Sodium bicarbonate in chemical flooding: Part 1: Topical report. Peru, D.A.; Lorenz, P.B. (National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)). Jul 1987. Contract FC22-83FE60149. 37p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87001246.

To compare oil recovery and alkali consumption in alkaline flooding using sodium bicarbonate with other alkaline agents, coreflooding experiments were performed in turn with viscosified sodium bicarbonate and viscosified sodium carbonate solutions. Oil recovery was monitored, and the effluent brine from these corefloods was analyzed for silicon, aluminum, pH, and total inorganic carbon. The results indicate that viscosified sodium bicarbonate recovered more of the asphaltic Cerro-Negro crude than of the less asphaltic Wilmington crude oil. The recovery efficiency using the viscosified sodium carbonate was similar for the two crudes. For both crudes, the percent oil recovery using viscosified sodium carbonate was slightly higher than that using the viscosified sodium bicarbonate. Mineral dissolution and decrease in pH were found to be greater in corefloods using viscosified sodium carbonate. Total inorganic carbon recovery can be obtained in corefloods with either agent, provided that a sufficient water drive follows the chemical slug. Long-term experiments were performed by recirculating alkaline solutions through oil-free, unfired Berea sandstone to monitor the rock/alkali interactions. The experimental results indicate an eight-fold decrease in quartz dissolution by sodium bicarbonate compared with sodium carbonate. Moderate magnesium solubility was observed at the pH of the bicarbonate solution. Low solubility of magnesium and aluminum at the pH of the carbonate indicates the possible formation of precipitates. In these experiments 13% of the carbonate was converted to bicarbonate. Total alkalinity was not significantly decreased with either agent. 18 refs., 5 tabs.

40431 (UCRL—97053) Multi-phase flow in porous medida: Mechanics, mathematics and numerics. Trangenstein, J.A. (Lawrence Livermore National Lab., CA (USA)). Jul 1987. Contract W-7405-ENG-48. 161p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE87013113.

The past decade has seen remarkable growth in research related to petroleum reservoir simulation. This growth reflects several developments, not the least of which is the increased interest in oil recovery technologies requiring sophisticated engineering. Augmenting this interest has been the broader availability of supercomputers capable of handling the tremendous computational demands of a typical reservoir simulator. The field of reservoir simulation incorporates several major facets of applied mathematics. First, in view of the variety and complexity of the processes encountered, it is imperative that the modeler adopt a systematic approach to establishing the equations governing reservoir flows. Second, the mathematical structure of these flow equations needs to be carefully analyzed in order to develop appropriate and efficient numerical methods for their solution. Third, since some aspects of the discretized flow equations are typically stiff, one must develop efficient schemes for solving large sparse systems of linear equations. This monograph has three parts, each devoted to one of these three aspects of reservoir modeling. The text grew out of a set of lectures presented by the authors in the autumn of 1986 at the IBM Scientific Center in Bergen, Norway. The authors feel that it is only appropriate to caution the reader that many of the ideas that we present in this monograph do not reflect standard approaches in petroleum reservoir simulation. In fact, their aim is to outline promising new ways of attaching reservoir simulation problems, rather than to compile another textbook for the mainstream.

0204 Processing

REFER ALSO TO CITATION(S) 40348

0205 Products And By-products

40432 (AD-A—179731/5/XAB) General aviation activity and avionics survey. Annual summary report, CY 1985. (Department of Transportation, Cambridge, MA (USA). Transportation Systems Center). Mar 1987. 290p. (DOT-TSC-FAA—87-2). NTIS, PC A13/MF A01.

This report presents the results and a description of the 1985 General Aviation Activity and Avionics Survey. The survey was conducted during 1986 by the FAA to obtain information on the activity and avionics of the United States registered general aviation aircraft fleet, the dominant component of civil aviation in the U.S. The survey was based on a statistically selected sample of about 10.3 percent of the general aviation fleet. A responses rate of 63.7 percent was obtained. Survey results based upon response but are expanded upward to represent the total population. Survey results revealed that during 1985 an estimated 34.1 million hours of flying time were logged and 88.7 million operations were performed by the 210,654 active general aviation aircraft in the U.S. fleet. The mean annual flight time per aircraft was 158.2 hours. The active aircraft represented about 77.9 percent of the registered general aviation fleet. The report contains breakdowns of these and other statistics by manufacturer/model group, aircraft, state and region of based aircraft, and primary use. Also included are fuel

consumption, lifetime airframe hours, avionics, engine hours, and miles flown estimates, as well as tables for detailed analysis of the avionics capabilities of the general aviation fleet. New to the report this year are estimates of the number of landings, IFR hours flown, and the cost and grade of fuel consumed by the GA fleet.

40433 **(AD-A—180284/2/XAB) Study of variables that affect results in the ASTM D2274 accelerated-stability test. Part 1. Laboratory, operator, and process-variable effects. Research and development report.** White, E.W. (David W. Taylor Naval Ship Research and Development Center, Annapolis, MD (USA). Ship Materials Engineering Dept.). Apr 1987. 58p. (DTNSRDC/SME—86/77). NTIS, PC A04/MF A01.

Poor reproducibility among laboratories that use the ASTM D2274 test for the storage stability of distillate fuels has long been a problem. Different operators who use the same equipment obtained different average results even within a single laboratory. A questionnaire relating to the method was sent to users to elicit information about variations in practice among laboratories and to gain insight into the causes. This Center began a task to identify the critical variables in the test procedure by testing three fuels. It was concluded that there is negligible effect from variations in the bath temperature of less than 0.2 C, in oxygen flow rate of less than 0.3 L/hr, and of time-in-bath of less than 0.25 hr. However, each of these variables (especially the temperature) has a major impact if the limits are exceeded.

0207 Marketing And Economics

REFER ALSO TO CITATION(S) 41116

40434 **(AD-A—180277/6/XAB) Strategic implications for US - Persian Gulf relations on domestic and worldwide oil production for future US oil demand. Final report.** Kaplan, S.S. (Naval War Coll., Newport, RI (USA)). Mar 1987. 116p. (NUC/ARP—87-07). NTIS, PC A06/MF A01.

The U.S. dependence on oil imports is examined in light of current U.S. oil production, its potential for future discoveries, and the availability of oil products form Venezuela, Mexico, and other South American countries. There is no geologic reason why the U.S. cannot continue to replace its reserves consumed annually, continue conservation efforts reducing its import dependence, and shift its foreign oil supply closer to home, i.e., Mexico and South America. Increasing the price of oil domestically ensures continued exploration, and shifting the source of imports reduces the length of SLOC'S carrying critical oil products.

40435 **World oil outlook. Hearings before the Committee on Energy and Natural Resources, United States Senate, One Hundredth Congress, First Session, January 22 and March 11, 1987.** Washington, DC; Government Printing Office (1987). 191p.

Dr. James E. Akins, Ambassador to Saudi Arabia, James R. Schlesinger of the Georgetown Center for Strategic and International Studies, Dr. Daniel Dreyfus of the Gas Research Institute, Dr. Scott Jones of Chase Econometrics, Inc., and Dr. John H. Lichtblau of the Petroleum Industry Research Foundation were the principal witnesses at a hearing held to review the potential for another oil crisis due to reduced domestic production and exploration and a diminished capability in both areas. Statements made by several senators reviewed the dangers of depending upon Middle East oil imports and the threat of an energy problem more serious than those of 1973 and 1979. Of primary concern was the need to retain a healthy domestic petroleum industry in the wake of fluctuating prices and restrengthening of OPEC as a cartel. Additional material submitted by Americans for Energy Independence follows the two-day testimony of the 16 witnesses.

0209 Environmental Aspects

REFER ALSO TO CITATION(S) 42000, 42002, 42003, 42004, 42005

40436 **(NP—7770236) Experimental studies on the formation of plumes of emissions from pressure vessels.** Schenk, V. (Stuttgart Univ. (Germany, F.R.). Fakultaet 3 - Chemie). 27 Oct 1986. 137p. (In German). NTIS (US Sales Only), PC A07. File Number DE87770236.

In case of toxic emissions from petroleum-processing and chemical plants, the central determining factor is the dispersion of the pollutant clouds due to atmospheric turbulence at a distance of 100 to 1000 m from the source. The dispersion parameters, mass flows and mean mass flow rates of unsteady free jets of nitrogen/soot mixtures are determined in an experiment. The temperature distributions at the source and in the initial phase of plume formation are investigated using a thermographic camera.

40437 **(PB—87-189551/XAB) Outer Continental Shelf environmental assessment program. Final reports of principal investigators. Volume 38.** (National Ocean Service, Anchorage, AK (USA). Ocean Assessments Div.). Apr 1986. 741p. NTIS, PC A99/MF E04.

See also PB—87-107546, PB—87-189585, PB—87-189569 and PB—87-189577.

Environmental characterization of the north Aleutian shelf nearshore region is presented; (Characterization, processes, and vulnerability to development; Annotated bibliography and key word index).

40438 **(PB—87-189569/XAB) Environmental characterization of the north Aleutian shelf nearshore region: characterization, processes, and vulnerability to development.** Pace, S. (National Ocean Service, Anchorage, AK (USA). Ocean Assessments Div.). Mar 1984. 470p. NTIS, PC A99/MF E04.

The specific objectives of the study are as follows: Describe the present status of knowledge concerning the biotic communities and organic productivity of the nearshore zone along the entire North Aleutian Basin lease area, (Unimak Pass to Cape Newenham), with particular reference to the area adjacent to Izembek Lagoon; Describe the ecological processes which might be causing the observed distributions, densities, and interrelationships; Discuss potential vulnerability of this region to impacts from offshore oil and gas development; Identify significant data and information needs.

40439 **(PB—87-189577/XAB) Environmental characterization of the north Aleutian shelf nearshore region: annotated bibliography and keyword index.** Pace, S. (National Ocean Service, Anchorage, AK (USA). Ocean Assessments Div.). Mar 1984. 266p. NTIS, PC A99/MF E04.

Contents include: Author index; Annotated bibliography and key word index.

40440 **(PB—87-189619/XAB) Wave hindcast statistics for the Hope Basin, North Chukchi and South Chukchi areas.** Kozo, T.L. (National Ocean Service, Anchorage, AK (USA). Ocean Assessments Div.). 1984. 94p. NTIS, PC A15/MF A01.

Wave predictions are necessary to determine the months and locations of highest risk for oil and gas development in the Chukchi Sea area. A wave hindcast scheme was used to characterize extreme wave conditions in Regions A, B and C for prescribed fetch distances. These fetch conditions were controlled by both ice cover and coastline orientation thereby becoming highly directionally dependent. Region C containing the Hope Basin and Kotzebue Sound has four primary coastline orientations. Monthly wind statistics from designated land stations bordering the Chukchi study regions and/or designated marine areas containing the Chukchi study areas were used as model wind field input.

40441 **(PB—87-190336/XAB) VOC (volatile organic compounds) emissions from petroleum-refinery wastewater systems--background information for proposed standards. Final report.** (Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards). Feb 1985. 318p. (EPA—450/3-85/001A). NTIS, PC A14/MF A01.

Background information is presented for the purpose of providing technical data considered in the development of new source performance standards (NSPS) for petroleum-refinery waste-water systems under the authority of Section 111 of the Clean Air Act. Three emission sources in a petroleum-refinery waste-water treatment system are discussed in terms of their design and operating characteristics, factors affecting emissions of volatile organic compounds (VOC), emission-control techniques, and emission control costs. The three sources are: process drain systems; oil-water separators; and air-flotation systems. The report also identified model facilities and regulatory alternatives for which environmental, cost, and economic impacts are presented.

40442 **(PB—87-191946/XAB) Outer Continental Shelf environmental assessment program. Final reports of principal investigators. Volume 40.** (National Ocean Service, Anchorage, AK (USA). Ocean Assessments Div.). Jun 1986. 469p. NTIS, PC A20/MF A01.

See also Volume 39, PB—87-189585, Volume 41, PB—87-192043, and PB—87-191953 through PB—87-192035.

Contents include: Interaction of oil with sea ice; Physical oceanographic investigations in the Bering Sea marginal ice zone; The movement and decay of ice edge bands in the winter Bering Sea; On some possible interactions between internal waves and sea ice in the marginal ice zone; The Bering Sea ice cover during March 1979: Comparison of surface and satellite data with the Nimbus-7, SMMR; Persistence of spilled oil along the Beaufort Sea coast; Potential oiled ice trajectories in the Beaufort Sea; Interaction of oil with artic sea ice; Activity-directed fractionation of petroleum samples.

40443 **(PB—87-191961/XAB) Interaction of oil with sea ice. Appendix 1. Physical oceanographic investigations in the Bering Sea marginal ice zone.** Muench, R.D. (National Ocean Service, Anchorage, AK (USA). Ocean Assessments Div.). Dec 1981. 53p. NTIS, PC A20/MF A01.

A physical oceanographic field program was carried out in the Bering Sea marginal ice zone (MIZ) as part of an integrated research effort addressing air-ice-water interactions in the MIZ and relating these interactions to fate and transport of OCS-related pollutants. This report describes and discusses the temperature, salinity, and current observations and relates the conditions summarily to past work and to current hypotheses concerning regional processes.

40444 **(PB—87-191995/XAB) Interaction of oil with sea ice. Appendix 4. The Bering Sea ice cover during March 1979: comparison of surface and satellite data with the Nimbus-7 smmr (scanning multichannel microwave radiometer).** Martin, S.; McNutt, S.L.; Cavalieri, D.J.; Gloersen, P. (National Ocean Service, Anchorage, AK (USA). Ocean Assessments Div.). Jan 1982. 53p. NTIS, PC A20/MF A01.

During March 1979, field operations were carried out in the Marginal Ice Zone (MIZ) of the Bering Sea. This report presents the results of a comparison between surface and aircraft observations, and images from the Tiros-N satellite, with ice concentrations derived from the microwave radiances of the Nimbus-7 Scanning Multichannel Microwave Radiometer.

40445 **(PB—87-192001/XAB) Persistence of spilled oil along the Beaufort Sea coast.** Nummedal, D. (National Ocean Service, Anchorage, AK (USA). Ocean Assessments Div.). Apr 1980. 75p. NTIS, PC A20/MF A01.

The research project for which this is the final report was initiated in 1977 with the following three major objectives: Assess the retention potential for spilled oil within the coastal environments of Alaska's Beaufort Sea; Characterize the morphology and sediments of the Beaufort coast; Determine, as precisely as possible, the annual longshore sediment transport rate.

40446 **(PB—87-192019/XAB) Potential oiled ice trajectories in the Beaufort Sea.** Thomas, D.R. (National Ocean Service, Anchorage, AK (USA). Ocean Assessments Div.). Jan 1983. 102p. NTIS, PC A20/MF A01.

To perform oil-spill risk analysis, it is necessary to describe the behavior and fate of the spilled oil from the time of the spill until it is no longer a threat to the environment. This description takes the form of a prediction of the most likely set of events that will follow an oil spill. One important conclusion of the scenario outlined above is that an offshore oil spill during the ice season will probably not have significant effects on the environment until breakup the following spring.

40447 **(PB—87-192027/XAB) Interaction of oil with arctic sea ice.** Thomas, D.R. (National Ocean Service, Anchorage, AK (USA). Ocean Assessments Div.). Feb 1983. 33p. NTIS, PC A20/MF A01.

The purpose of the paper is to summarize relavant knowledge about the interactions between arctic sea ice and oil. The completion of further experimental oil spill studies, along with recent laboratory studies of the interaction of oil and sea ice and studies of environmental conditions, makes an updating of those works desirable. An attempt is made to identify the major factors in the interaction between oil and arctic sea ice and to present them in a way that defines the scope of the problem. Generally, the paper is restricted to factors that can be expected to play a major role in the sequence of events following a large under-ice blowout in the Beaufort Sea during winter.

40448 **(PB—87-192035/XAB) Activity-directed fractionation of petroleum samples.** Warner, J.S.; Margard, W.L.; Anderson, J.W. (National Ocean Service, Anchorage, AK (USA). Ocean Assessments Div.). Oct 1979. 62p. NTIS, PC A20/MF A01.

A fractionation and bioassay scheme was developed that can be applied to oil samples to assess the potential biological hazards of the various components that remain after an oil spill. The fractionation procedure involves solvent partitioning between heptane and acetonitrile, gel permeation chromatography using Bio-Beads S-X8, and silica gel chromatograpy. The first two steps are effective in removing intractable components that otherwise interfere with bioassay studies. Two in vitro bioassay tests and an in vivo test were studied to assess toxicity and mutagenicity of oil fractions. These were (1) the Ames bacterial mutagenicity test, (2) a mammalian-cell toxicity test, and (3) a mysids toxicity test. All three tests can be run using no more than a total of 30 mg of material.

40449 **(PB—87-192043/XAB) Outer continental shelf environmental assessment program. Final reports of principal investigators. Volume 41.** (National Ocean Service, Anchorage, AK (USA). Ocean Assessments Div.). Jun 1986. 495p. NTIS, PC A21/MF A01.

See also Volume 40, PB—87-191946, Volume 42, PB—87-192084, and PB—87-192050 through PB—87-192076.

Contents include: Distribution and elemental composition of suspended matter in Alaskan coastal waters; Tidal data from the Bering, Chukchi, and Beaufort seas; Nearshore coastal currents--Chukchi Sea, Summer 1981.

40450 **(PB—87-192050/XAB) Distribution and elemental composition of suspended matter in Alaskan coastal waters.** Feely, R.A.; Massoth, G.J.; Paulson, A.J.; Lamb, M.F. (National Ocean Service, Anchorage, AK (USA). Ocean Assessments Div.). Sep 1980. 146p. NTIS, PC A21/MF A01.

The distribution of suspended matter in the northeastern Gulf of Alaska is affected by a number of parameters which combine to form a unique distribution pattern. East of Kayak Island the surface particulate matter distributions are dominated by the discharge of sedimentary material from the coastal streams which drain the Beering, Guyot and Malaspina Glaciers. The major source of sedimentary material to the Gulf of Alaska is the Copper River. In general, concentrations of suspended matter in the northeast Gulf of Alaska are high at the surface with an average concentration of approximately 1.0 mg/l. Recent studies of oil spills in coastal waters containing high suspended loads have indicated rapid

dispersal and removal of the oil by sorption onto particles along frontal zones.

40451 **(PB—87-192068/XAB) Tidal data from the Bering, Chukchi, and Beaufort Seas.** Pitman, R.W. (National Ocean Service, Anchorage, AK (USA). Ocean Assessments Div.). May 1984. 56p. NTIS, PC A21/MF A01.

The report relates Brown and Caldwell's activities for the Outer Continental Shelf Environmental Assessment Program (OCSEAP) project entitled Oceanographic Data for the Bering, Chukchi and Beaufort Seas. The purpose of the project was to obtain and process measurements of tide along the Alaskan coast from Norton Sound north to Pt. Barrow and east of Pt. Barrow to the United States/Canada Border. The tidal circulation model is a submodel of an oil-spill risk analysis, and knowledge of the tidal circulation is required in order to estimate oil spill transport.

40452 **(PB—87-192118/XAB) Outer Continental Shelf environmental assessment program. Final reports of principal investigators. Volume 43.** (National Ocean Service, Anchorage, AK (USA). Ocean Assessments Div.). Jun 1986. 662p. NTIS, PC A99/MF A01.

See also Volume 42, PB—87-192084, Volume 44, PB—87-192233, and PB—87-192126 through PB—87-192225.

Contents include: Assessment of gray whale feeding grounds and sea floor interaction in the northeastern Bering Sea; Feeding ecology of the gray whale in the northern Bering Sea; Feeding ecology of the gray whale in the Chirikof Basin, summer 1982; Project rationale, design, summary; Distribution, production, and ecology of gray whale prey species; Distribution and abundance of gray whales in the Chirikof Basin, summer 1982; Assessment of gray whale feeding grounds and sea floor interaction in the northeastern Bering Sea; Feeding ecology of gray whales in the Chirikof Basin; Investigations of belukha whales in coastal waters of western and northern Alaska, 1982-1983: marking and tracking of whales in Bristol Bay; Belukha whale responses to industrial noise in Nushagak Bay, Alaska.

40453 **(PB—87-192217/XAB) Belukha whale (delphinapterus leucas) responses to industrial noise in Nushagak Bay, Alaska: 1983.** Stewart, B.S.; Awbrey, F.T.; Evans, W.E. (National Ocean Service, Anchorage, AK (USA). Ocean Assessments Div.). 1983. 26p. NTIS, PC A99/MF A01.

Between 15 June and 14 July 1983 the authors conducted playback experiments with belukha whales in the Snake River, Alaska, using sounds recorded near an operating oil-drilling rig. The objectives of these experiments were to quantify behavioral responses of belukha whales to oil drilling noise in an area where foreign acoustic stimuli were absent, and to test the hypothesis that beluhka whales would not approach a source of loud sound.

40454 **(PB—87-192225/XAB) Lethal and sublethal effects of oil on food organisms (euphausiid: Thysandessa raschii) of the bowhead whale.** Fishman, P.A.; Caldwell, R.S.; Vogel, A.H. (National Ocean Service, Anchorage, AK (USA). Ocean Assessments Div.). Dec 1985. 82p. NTIS, PC A99/MF A01.

The study was contracted for the purpose of investigating the sensitivity of Arctic krill, namely the euphauslid Thysanoessa raschii, to the water soluble fraction (WSF) of Prudhoe Bay crude oil. The study had two primary objectives: (1) determine, through laboratory bioassays, the 96-hr LC50 of Prudhoe Bay crude oil WSF for T. raschii; and (2) estimate the losses to populations of T. raschii and the potential recovery rates resulting from hypothetical oil spills in the Beaufort Sea. The major concern prompting the study is the fact that euphauslids are a major food source for the endangered bowhead whale in the western Beaufort Sea.

40455 **(PB—87-192530/XAB) Simulation modeling of the effects of oil spills on population dynamics of northern fur seals.** Reed, M.; French, D.; Calambokidia, J.; Cubbage, J. (Applied Science Associates, Inc., Narragansett, RI (USA)). Mar 1987. 180p. (ASA—84-17). NTIS, PC A09/MF A01.

Previously announced as PB—87-116042.

Population dynamics and migration models were developed and combined with an oil-spill simulation model to determine the effects of oil spills on the Pribilof Island fur seal (Callorhinus ursinus) population. In the population-dynamics model, mortality of pups on land and juveniles up to two years of age is density dependent, while that of older seals is age- and sex-specific and constant at all population sizes. Movement patterns of seals within the Bering Sea are functions of date, sexual status, and age. Two hypothetical 10,000 barrel oil spill simulations were performed. Depending on the assumed oil-induced mortality rate in the range 25%-100%, effective recovery of the population from these spills, i.e., the number of years before the oil-affected population numbers, took 0 to 25 years.

40456 **Structure-activity relationships in a model of the fates and effects of PAH's in aquatic ecosystems.** Bartell, S.M. (Oak Ridge National Lab., Oak Ridge, TN). pp 323-324 of Proceedings of the symposia of the division of environmental chemistry of the American Chemical Society. Washington, DC; American Chemical Society (1987). (CONF-870410—). Contract AC05-84OR21400.

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

Structure-activity relationships are frequently used in environmental toxicology to estimate the equilibrium concentrations of chemicals of concern in water, sediments, and organisms. For example, the accumulation of nonpolar aromatic hydrocarbons by planktonic invertebrates and fishes has been routinely estimated from the octanol:water partition coefficients (Kow) measured or calculated for these compounds. Similarly, the accumulation of these chemicals in suspended particulate matter and sediments has been estimated as a function of the Kow of the particular hydrocarbon and the organic matter content of the particulates or the sediments. To the extent that the equilibrium assumptions are valid in particular applications, these relations may provide useful estimates of the expected concentration of potential toxicants in important components of aquatic systems. The purpose of work reported here was to develop a model for forecasting the fate and effects of polycyclic aromatic hydrocarbons (PAHs) under nonequilibrium conditions in aquatic systems. The model follows the dissolution of a PAH from a surface oil slick and simulates the time-varying concentration of the compound in water, sediments, suspended particulates, and populations of rooted vegetation, phytoplankton, zooplankton, attached algae, bacteria, benthic invertebrates, omnivorous fish, and benthic detritus-feeding fish. The modeled transport and fate processes include photolytic degradation, volatilization, sorption, and bioaccumulation of dissolved PAH.

0230 Properties

REFER ALSO TO CITATION(S) 40355

40457 **(NIPER—205) Effects of lead level on emissions and valve seat recession: Final report.** Allsup, J.R. (National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)). Aug 1987. Contract FC22-83FE60149. 42p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87001253.

This report describes testing operations to determine the effect of using unleaded gasoline in engines designed for leaded gasoline. Three tractor engines, one combine engine, one light-duty farm truck engine, and one heavy-duty truck engine were tested using leaded fuel (1.1 gm/gas), unleaded fuel, and low lead fuel (0.10 gm/gas). Results show the higher speed engines experienced valve seat recession using unleaded fuel while lower speed engines did not show valve recession using the unleaded fuel. No valve seat recession occurred using the 1.1 gm/gas leaded fuel. The use of .10 gm/gal lead reduced valve seat recession compared to unleaded fuel, but did not eliminate recession in all cases. 20 tables.

40458 **(NIPER—245) Stability and compatibility of residual fuel oils: Topical report.** Anderson, R.P.; Goetzinger, J.W.; Reynolds, J.W.; Brinkman, D.W. (National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Aug 1987. Contract FC22-83FE60149. 297p. NTIS, PC A13. File Number DE87001254.

In recent years there has been an increased use of low quality crudes in refinery feedstocks. This results from several factors including the depletion of light, sweet domestic crude oils and the growing dependence upon heavy, sour crudes from both domestic and foreign sources. Refiners have found it necessary to increase the conversion of resid to distillate fuels which has resulted in increased problems in product quality. Experience has shown that conventional fuel oil analyses are inadequate to allow prevention or prediction of handling problems resulting from fuel instability or incompatibility of fuel mixtures. A number of "problem" and "nonproblem" fuels supplied by utilities were analyzed in an attempt to understand the reasons for the reported problems. These fuels were carefully characterized by the determination of chemical and physical properties. It was apparent, however, that a baseline or reference test was needed to categorize the fuels as "problem" and "nonproblem." Therefore, supplemental samples were obtained through the cooperation of participating utilities, and these and initial samples were subjected to baseline tests for determining stability and compatibility characteristics. These baseline tests were the basis for the evaluation of rapid tests which might be useful for the prediction of potential problems. Some of the simple techniques which were evaluated for usefulness in predicting instability or incompatibility potential included determination of sediment by hot filtration (existent dry sludge), determination of potential dry sludge (Shell accelerated stability test), determination of coke content, a modified spot test and prediction of incompatibility between fuels through the use of the Bureau of Mines correlation Index and toluene equivalence. The conclusions of this program of research are presented in a final section. 344 refs., 51 figs., 53 tabs.

0240 Storage

REFER ALSO TO CITATION(S) 40433

0250 Combustion

REFER ALSO TO CITATION(S) 40683

40459 (FRNC-TH—2328) Statistical analysis of submicronic particles emitted from heavy fuel oils combustion. Capron, R. (Rouen Univ., 76 - Mont-Saint-Aignan (France)). 1983. 194p. (In French). NTIS (US Sales Only), PC A09/MF A01. File Number DE87752535.

Analysis of heavy fuel ashes collected from an Andersen impactor and transferred on the grid of an electron microscope with an ultracentrifuge shows 4 morphologic types and 3 different particle size. Observation of metallic contaminants suggests their intervention in combustion mechanism. Particle size below 1000 A is related to oxygen ratio in the premixing flame. Morphologic analysis by studying linear regression of the different fractions surface measurement and perimeter of these particles shows a relationship between particle type, fuel type and sulfur content.

03 NATURAL GAS

0302 Geology And Exploration

REFER ALSO TO CITATION(S) 40398, 40421, 40422, 40423, 40424, 40425

40460 (SAND—87-1542C) Multiwell experiment: Geology. Lorenz, J.C. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 22p. (CONF-870728—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012395.

From Unconventional gas recovery and utilization; Morgantown, WV, USA (28 Jul 1987).

The general objective of the Multiwell Experiment geology study is the detailed characterization of the low-permeability gas reservoirs of the Mesaverde Formation at the MWX site. The ultimate objective of the study is the understanding of how the detailed characteristics affect completion, stimulation, and production of these reservoirs, and the successful extrapolation of this knowledge to other low-permeability reservoirs. Low-permeability sandstone reservoirs contain significant reserves of natural gas in the US, but these reserves are difficult to exploit. Much of this difficulty is attributable to an insufficient data base on the sedimentological and fracture characteristics of the reservoirs. These characteristics strongly control not only reservoir porosity and permeability, but they also control total reservoir volume, internal reservoir heterogeneity, and susceptibility of the reservoir to damage by different drilling and stimulation techniques. The recognition alone by operators that these are indeed controlling factors is a significant step in the utilization of the low-permeability reserves, and this is one of the important results of this study. However, the implementation of techniques that have been derived using the data base assembled from this study is the next step of the program. 15 refs.

0303 Drilling, Production, And Processing

REFER ALSO TO CITATION(S) 41480, 42307

40461 (SAND—87-1541C) Multiwell experiment: Overview. Lorenz, J.C.; Sattler, A.R.; Warpinski, N.R.; Thorne, B.J.; Branagan, P.T. (Sandia National Labs., Albuquerque, NM (USA); CER Corp., Las Vegas, NV (USA)). 1987. Contract AC04-76DP00789. 9p. (CONF-870728—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012396.

From Unconventional gas recovery and utilization; Morgantown, WV, USA (28 Jul 1987).

This field laboratory has been established about 7 mi southwest of Rifle, Colorado. Here the Mesaverde formation lies at a depth of 4000 to 8250 ft. This interval contains different, distinct reservoir types depending upon their depositional environments. These different zones serve as the focus of the various testing and stimulation programs. One key to the Multiwell Experiment is three closely spaced wells. Their 110 to 215 ft separation at depth is less than the nominal dimensions of the lenses in the area. Core, log, well testing, and well-to-well seismic data are providing a far better definition of the geological setting than has been available previously. Comprehensive logging and core analysis programs were conducted. The closely spaced wells also allow interference and tracer tests to obtain in situ reservoir parameters. The vertical variation of in situ stress throughout the intervals of interest is being measured. A series of stimulation experiments is being conducted in one well and the other two wells are being used as observation wells for improved fracture diagnostics and well testing. Another key to achieving the Multiwell Experiment objectives is the synergism resulting from a broad spectrum of activities: geophysical surveys, sedimentological studies, core and log analyses, well testing, in situ stress determination, stimulation, fracture diagnostics, and reservoir analyses. The results from the various activities will define the reservoir and the hydraulic fracture. These, in turn, define the net pay stimulated: the intersection of a hydraulic fracture of known geometry with a reservoir of known morphology and properties. These definitions are further enhanced by the fact that most data will come from closely spaced wells. Thus, spatial variations in reservoir properties can be quantified. 10 refs.

40462 (SAND—87-1543C) Multiwell experiment: Fracturing experiments. Warpinski, N.R.; Sattler, A.R.; Branagan, P.T.; Cipolla, C. (Sandia National Labs., Albuquerque, NM (USA); CER Corp., Las Vegas, NV (USA)). 1987. Contract AC04-76DP00789. 8p. (CONF-870728—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012398.

From Unconventional gas recovery and utilization; Morgantown, WV, USA (28 Jul 1987).

Because of the complexity of the stimulation, no conventional analyses were useful, so we decided to concentrate on the minifrac to provide important fracture parameters. The minifrac was conducted in an identical manner to the pressure-up and pad stages of the stimulation. Figure 1 shows two initial pressure-history match calculations that were performed to model the minifrac. We found that the pressure behavior could not be matched with any normal behavior. Examining the field pressure data, we see that the interesting feature is the sudden flattening in the pressure at a level 1050 psi above the closure stress during pumping and the rapid drop to this same level at shut-in, after which the pressure decreases much more slowly. We first tried to match this behavior

using enhanced height growth. While height growth can flatten the pressure during pumping, it also causes a very slow pressure decline at shut-in. We also tried additional leakoff height as height grew, but this could not flatten the pressure as much as needed. Finally, we tried an accelerated leakoff condition above 1050 psi. We did this by increasing the leakoff coefficient by a constant factor above some threshold value. To keep the results smooth and code convergent, we actually linearly phased in the increased leakoff between 1000 and 1100 psi. The final result of these calculations is shown in Figure 2; a factor of 50 increase in the leakoff coefficient was required to match the data for pressures above 1050 psi.

40463 **(SAND—87-1544C) Fracturing experiments: Nevada Test Site.** Warpinski, N.R.; Chu, T.Y. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 7p. (CONF-870728—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012397.

From Unconventional gas recovery and utilization; Morgantown, WV, USA (28 Jul 1987).

The purpose of this program is to develop techniques for efficient and economic recovery of natural gas from low permeability reservoirs in both Western US basins and the Eastern Appalachian area. Experiments have been conducted at G-tunnel to improve this conventional technology and to develop novel techniques for improved recovery. These experiments offer a unique opportunity to perform fracturing research under conditions combining the best aspects of field tests and laboratory experiments; they are conducted under realistic in situ conditions, yet mining allows for direct observation. The development of controlled-pulse fracturing technology has been the major focus of the program the last two years. We find that explosive fracturing can often have detrimental results such as crushing, a stress cage, and reduced permeability. Hydraulic fracturing produces a single fracture which may not adequately drain a naturally fractured reservoir. A controlled-pulse-fracturing stimulation can result in multiple fratures extending in all directions. This is attractive for draining naturally fractured reservoirs. 11 refs.

40464 **(SAND—87-1675C) Differences in fracture characteristics and related production of natural gas in different zones of the Mesaverde Formation, northwestern Colorado.** Lorenz, J.C.; Finley, S.J. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 18p. (SPE—16809; CONF-870913—1). Society Petroleum Engineers, 222 Palisade Creek Dr., Richardson, TX 75080. File Number TI87012731.

From Annual technical conference and exhibition of the Society of Petroleum Engineers; Dallas, TX, USA (27 Sep 1987).

Reservoirs in the Mesaverde Formation in the Piceance Creek basin, northwestern Colorado, consist of naturally fractured, low permeability sandstones. Permeability along the natural fractures is the primary mechanism of gas production. However, the characteristics of the natural fractures change within the formation at boundaries roughly coincident with changes in depositional environment, as seen in 4200 ft (1280 m) of core from the US Department of Energy's Multiwell Experiment wells. Depositional environment controlled the characteristics of the matrix rock and reservoir heterogenity as well as, commonly, the fracture permeability system. Therefore, rates of production of natural gas from the different zones in the formation can be correlated with the natural fracture characteristics from that zone. The fracture systems consist of unidirectional regional fractures that provide highly anisotropic reservoir permeability trends. Locally, secondary fractures were superimposed on the regional system, and higher production rates result. Elsewhere, production rates are low, and little well-to-well communication across the fracture trend occurs. Moreover, stimulations of these reservoirs have often been unsuccessful because the hydraulic fractures propagate parallel to the natural fracture trend. 13 refs., 8 figs., 1 tab.

40465 **(UCID—21108) Status of the Western Gas Sands Project at Lawrence Livermore National Laboratory.** Heuze, F.E. (Lawrence Livermore National Lab., CA (USA)). Jul 1987. Contract W-7405-ENG-48. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013117.

The objective of the LLNL Western Gas Sands (WGS) subprogram is to improve the understanding of the stimulation mechanics of lenticular and jointed tight gas reservoirs. Particular emphasis is put on the interaction of induced fractures with natural fractures, and on the determination of relevant rock mass properties for input in hydrofracture simulators. The project is a combined experimental and numerical modeling effort. The main thrust is the development and verification of computer models to analyze hydrofracturing in complex rock formations. 15 refs.

0308 Environmental Aspects

REFER ALSO TO CITATION(S) 40437, 40438, 40439, 40440

0309 Artificial Stimulation

REFER ALSO TO CITATION(S) 40464

40466 **(SAND—87-1612C) Multi-well experiment: Fracture diagnostics.** Thorne, B.; Morris, H. (Sandia National Labs., Albuquerque, NM (USA)). Jul 1987. Contract AC04-76DP00789. 12p. (CONF-870728—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012722.

From Unconventional gas recovery and utilization; Morgantown, WV, USA (28 Jul 1987).

The fracture diagnostics subproject is part of the overall Multiwell project. One element of the Multiwell project is an investigation into the use of hydraulic fracture technology in lenticular tight gas sands. As part of this overall investigation the fracture diagnostics effort has the objective of developing technology to map the spatial and, if possible, temporal location of a hydraulic fracture. Techniques that have the potential to remotely map the fracture are being investigated. Recent work is focusing on mapping the fracture by detecting and locating microseisms that are emitted during the fracturing process. Specific objectives of the project include: Design and fabrication of borehole seismic hardware that can be utilized at the Multiwell and other appropriate sites. Develop data reduction algorithms that permit fracture maps to be obtained from detected microseism events. Evaluate the borehole seismic concept by fielding the system on various Multiwell experiments. On the basis of initial positive results, develop improved hardware and analysis procedures that overcome difficulties observed on early fielding exercises. 8 refs., 6 figs.

40467 **Coalbed methane production potential in U.S. basins.** Byer, C.W.; Mroz, T.H.; Covatch, G.L. (Morgantown Energy Technology Center, Morgantown, WV). *Journal of Petroleum Technology;* **39**: No. 7, 821-834(Jul 1987).

The major emphasis of the U.S. DOE's coalbed methane research has been on estimating the magnitude of the resource and developing systems for recovery. Methane resource estimates for 16 basins show that the greatest potential is in the Piceance, Northern Appalachian, Central Appalachian, Powder River, and Greater Green River coal basins. Small, high-potential target areas have been selected for in-depth analysis of the resource. Industry interest is greatest in the Warrior, San Juan, Piceance, Raton Mesa, and Northern and Central Appalachian basins. Production curves for several coalbed methane wells in these basins are included.

0310 Legislation And Regulation

40468 **Natural Gas Utilization Act of 1987. Hearing before the Subcommittee on Energy Regulation and Conservation of the Committee on Energy and Natural Resources, United States Senate, One Hundredth Congress, First Session on S. 85, March 12, 1987.** Washington, DC; Government Printing Office (1987). 418p.

Representatives of the energy production and service industries testified at a hearing on S. 85, which amends the Powerplant and Industrial Fuel Use Act of 1978 by relaxing restrictions on the end use of natural gas. Concerns about the proposal focused on potential job losses in the coal industry, the possibility that overall energy security would not improve, and the price and availability threat to those users dependent upon natural gas for processes. The short life expectancy of the gas bubble made the need for this legislation less persuasive. Arguing in favor of S. 85, representatives of

the gas industry pointed out the decline in well drilling and the need to keep natural gas competitive by not including coal capability incentives to the bill that might deny customers future supplies of gas. The hearing record includes the text of S. 85, which also repeals incremental pricing requirements, the testimony of 20 witnesses, and two appendices with responses and additional material submitted for the record.

0320 Transport, Pipelines, And Handling

40469 (EUR—9860) Compared economic and energy analysis of natural gas transport chains with on-shore pipelines, off-shore pipelines and by liquefaction. Montellanico, P.; Maineri, M. (Commission of the European Communities, Luxembourg). 1985. 377p. (In French). NTIS (US Sales Only), PC A17/MF A01. File Number DE87752554.

The report is relative to a detailed computer code which allows to state, starting from the physical data of the gas to be transported just as the throughput and the distance to be travelled over, in one hand the technical characteristics of the most economic pipeline and in the other hand the least gross energy requirement for pipeline construction and operation. The programme deals with on-shore pipelines as well as off-shore pipelines including compressor platforms. The analyses comparison is made in order to establish what are the practical possibilities to spare energy in the gas transportation sector. Both economic and energy analyses are then applied to LNG seaborne transportation. As a result it is possible to recover a part of the liquefaction energy for electricity production with very high efficiency. Finally the various transportation chains are compared in order to find out the economic break-even points. 68 refs.

0330 Properties

REFER ALSO TO CITATION(S) 41430

04 OIL SHALES AND TAR SANDS

0401 Reserves And Exploration

REFER ALSO TO CITATION(S) 40398

0403 Drilling, Fracturing, And Mining

40470 (PB—87-183968/XAB) Face ventilation for oil-shale mining. Information Circular/1986. Thimons, E.D.; Brechtel, C.E.; Adam, M.E.; Agapito, J.F.T. (Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research Center). 1986. 29p. (BM-IC—9118). NTIS, PC A03/MF A01.

Library of Congress catalog card No. 86-600361.

The Bureau of Mines report presents expected levels of air pollutants in the face areas of oil shale mines, based upon data collected by the authors and previous investigators. Ventilation requirements to maintain these pollutant levels below their threshold limit values and Federal and local mine air quality standards are discussed. Two practical face-ventilation systems are discussed in terms of actual in-mine test experience.

0404 Oil Production, Recovery, And Refining

REFER ALSO TO CITATION(S) 40326, 40478

40471 (DOE/FE/60177—2394) Evaluation of oil shale coking losses at slow heating rates. Guffey, F.D.; Cummings, R.E. (Western Research Inst., Laramie, WY (USA)). Jan 1986. Contract FC21-83FE60177. 24p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013744.

Currently available oil yield loss diagnostic methods are not adequate for evaluating oil yield losses of retorting systems operating in the indirect-heated mode at slow heating rates. A series of experiments have been performed in the Western Research Institute's laboratory reference retort to investigate coking losses occurring at slow retort heating rates. The conditions used for these experiments were selected for studying coking losses without interference from cracking reactions. This was done by using slow heating rates and a nitrogen sweep gas to remove oil vapor from the retort before it could undergo cracking reactions. Analysis of the produced oils using simulated distillation and combined gas chromatography/mass spectrometry (GC/MS) demonstrated the usefulness of applying both of these techniques to the evaluation of produced shale oils. Use of the two methods assisted in the identification of potential chemical indicators of coking. The results of this analysis demonstrated that the major components in the chromatographically separated peaks contain potential chemical indicators of coking. Combined GC/MS analysis of the produced shale oils also identified several normal alkanes that followed trends similar to those observed for the coking losses. Ratios of the reconstructed ion current chromatogram peak areas of the identified normal alkanes were used to develop three correlations relating the ratios of the normal alkanes to the oil yield losses caused by coking at slow retort heating rates. The linear regression analyses of these data fit the data to the functions with coefficients of determination of 0.98 and 0.99. The correlations developed from this effort are applicable only to retorting systems where the oil yield losses are caused by coking and where cracking or combustion do not occur. 9 refs., 3 figs., 6 tabs.

40472 Shale oil denitrogenation with ion exchange. Prudich, M.E.; Cronauer, D.C.; Marcelin, G. (Gulf Research & Development Co., Pittsburgh, PA). *Separation Science and Technology;* **22**: No. 2/3, 889-910(1987). (CONF-851011—). Contract AC19-80BC10313.

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

The nitrogen-containing aromatics normally found in crude retorted shale oils have been shown to be involved in reactions leading to the deposition of insoluble gums and sediments. These nitrogen-containing compounds must be removed in order to permit the effective utilization of the shale oil product. A process is proposed in which the nitrogen-containing compounds found in raw shale oil are removed by mild hydrodenitrogenation followed by resin ion exchange. Ion exchange data from experimentation involving six jet fuel (154-271°C) and diesel fuel (271-343°C) boiling point cuts are presented. Amberlyst A-15, a macroreticular, strongly acidic, cation exchange resin is used in this study. Three types of experiments were performed: batch sorption equilibrium experiments, batch sorption kinetics experiments, and dynamic ion-exchange column performance tests. The Langmuir isotherm was found to describe the equilibrium sorption behavior of the shale oil/ion-exchange resin system fairly well. The sorption kinetics are described using a quadratic-driving force model. Dynamic modeling, assuming intraparticle (solid) diffusion control and including the results of the batch equilibrium and batch kinetics experiments, provides reasonable prediction of the results of dynamic ion-exchange column performance tests.

0405 Properties And Composition

40473 (DOE/FE/60177—2395) A laboratory method for collecting volatile emissions from spent shale retorted by the Fischer assay method. Carroll, R.B.; Clark, J.; Raska, K. (Western Research Inst., Laramie, WY (USA)). Jan 1986. Contract FC21-83FE60177. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013781.

Organic compounds not removed in the oil shale retorting process are likely to remain with the retorted shale and may volatilize after the shale's removal from the retort. The purpose of the study was to determine if volatile organic emissions from the retorted oil shale were present in sufficient quantities to be detected in the laboratory. This study demonstrated that measurable quantities of volatile organic emissions are evolved from retorted shale and can be detected in the laboratory. Alkanes and alkenes were the primary compounds identified, although other organic compounds were detected. 6 refs., 4 figs., 2 tabs.

40474 **Quantitation of carbon types using DEPT/QUAT NMR pulse sequences: application to fossil-fuel-derived oils.** Netzel, D.A. (Western Research Institute, Laramie, WY). *Analytical Chemistry;* **59**: No. 14, 1775-1779(15 Jul 1987). Contract FC21-83FE60177.

A practical procedure is described whereby the fraction of carbon types (^{13}CH/sub n/, n = 0-3) in fossil-fuel-derived oils under ideal and nonideal experimental conditions can be quantitatively determined by using the pulse sequences DEPT (distortionless enhancement by polarization transfer) and QUAT (quarternary-only carbon spectra). Because these two techniques differ in the mechanism for signal enhancement, the NMR data are not directly related and, thus, a methodology was developed to relate the NMR data from the two techniques. The procedure was tested by using a pure compounds, o-ethyltoluene, and a model hydrocarbon mixture containing 10 components of known concentration. It is shown that a previously described method in the literature used to compensate for the missetting or field inhomogeneity of the ^{1}H pulse and to provide qualitatively good edited spectra can also be used to obtain quantitative carbon-type analysis. The methodology described is shown to be useful not only for pure compounds and simple mixtures but also for the analysis of complex mixtures such as fossil-fuel-derived products. The DEPT/QUAT technique is preferred over most quantitative spin-echo experiments because the time necessary for data acquisition and reduction is much less.

40475 **Organometallic geochemistry. 2. The molecular characterization of trace organometallic and inorganic compounds of arsenic found in Green River Formation oil shale and its pyrolysis product.** Fish, R.H.; Walker, W.; Tannous, R.S. (Univ. of California, Berkeley). *Energy and Fuels;* **1**: No. 3, 243-247(May-Jun 1987).

The isolation and molecular characterization of naturally occurring methyl- and phenylarsonic acids, 1 and 2, and the inorganic arsenic anion, arsenate, 3, from a Green River Formation oil shale sample were accomplished by separation on a high-performance liquid chromatograph (HPLC) coupled to a graphite-furnace atomic absorption spectrometer (GFAA) for arsenic detection. This was followed by a derivatization technique and analysis by capillary-column gas chromatography-mass spectrometry (GC-MS). The arsenate, 3, was also isolated via HPLC-GFAA analysis and derivatized to provide tris(trimethylsilyl) arsenate, which was also verified by GC-MS analysis. The pyrolysis of Green River Formation oil shale gives the corresponding shale oil. In addition, a neutral organoarsenic compound(s) was isolated from the oil shale sample by preparative HPLC; however, all attempts to verify its molecular-structure by GC-MS analysis as either trimethylarsine oxide or the corresponding phenyl derivative were unsuccessful. Extraction of a shale oil derived from the Paraho surface retort, with ammonium bicarbonate, gave indications of 1 and 3 and possible traces of 2 by HPLC-GFAA analysis. Derivatization of these extracts provided the identification of 1, but not 2, while 3 was verified by its tris (trimethylsilyl) derivative. The same compounds 1 and 3 were also isolated from the shale oil directly, by size-exclusion chromatography (SEC-HPLC), and identified via derivatization and GC-MS analysis. 25 refs., 7 figs.

0406 Direct Uses And By-products

40476 **(AD-A—180485/5/XAB) Shale JP-4 additive evaluation. Final report, September 1983-May 1985.** Boos, T.A.; Dues, T.L. (Air Force Wright Aeronautical Labs., Wright-Patterson AFB, OH (USA)). Oct 1986. 125p. (AFWAL-TR—85-2118). NTIS, PC A06/MF A01.

A shale JP-4 jet fuel was obtained from the Caribou Refinery of Woods Cross UT as the test fuel. Combinations of additives in varying concentrations were blended to make the test samples. The thermal and storage stability, lubricity, conductivity and water-separation characteristics of the samples were studied over 15 months. The additives chosen were nine antioxidants, at the minimum and two times the maximum concentration, and four corrosion inhibitors, at the minimum and maximum concentration. The limits were set by the JP-4 specification. Other additives in the test program were Fuel System Icing Inhibitor (FSII), anti-static additive, JFA-5 and metal deactivator. Five-gallon test samples were stored for 15 months: antioxidant samples in a 110 F oven and corrosion inhibitor samples in 70 F - 80 F room storage. Two drums of fuel containing FSII, anti-static additive, and maximum antioxidant and corrosion inhibitor were stored at other conditions, one in cold storage and one at ambient conditions (outdoors).

0407 Health And Safety

REFER ALSO TO CITATION(S) 40478

40477 **(DOE/FE/60177—2390) Toxicological characterization of water produced during simulated in situ processing of Green River formation oil shale.** Hill, S.L. (Western Research Inst., Laramie, WY (USA)). Sep 1986. Contract FC21-83FE60177. 29p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013437.

A study of the toxicity of R-17 oil shale process water to aquatic organisms has been completed. This water was generated during run 17 of a 150-ton capacity simulated in situ retort. The retort was supplied with Green River Formation oil shale from the Anvil Points mine in Colorado. Oil shale from the mine was subsequently designated the first interim western reference oil shale by the Department of Energy. Results of this study are, therefore, appropriate for inclusion in the Department of Energy reference oil shale data base. The toxic effects of untreated, treated, and fractionated R-17 process water were determined using bacteria (Microtox assay), zooplankton (Ceriodaphnia affinis/dubia), and fish (fathead minnow). A concentration of less than 1% process water was acutely toxic to all organisms tested. The toxicity of the water to the Microtox organism was substantially reduced following a treatment sequence of hot-gas stripping plus activated carbon adsorption plus reverse osmosis. However, the toxicity of the treated process water to Ceriodaphnia and fathead minnows remained relatively high with mortality occurring at concentrations of less than 10%. Tests of the major fractions of R-17 process water indicated that the organophilic fraction was more toxic to the Microtox organism, while the hydrophilic fraction was more toxic to Ceriodaphnia and fathead minnows. Un-ionized ammonia was identified as the principal constituent responsible for the toxicity of the hydrophilic fraction to Ceriodaphnia and fathead minnows. The toxicity of the treated process water to these organisms could have been further reduced by more effective removal of ammonia. 23 refs., 11 tabs.

0409 Waste Research And Management

REFER ALSO TO CITATION(S) 40397, 40477

0410 Environmental Aspects

40478 **(DOE/FE/60177—2389) The toxicity of Rio Blanco Tract C-a groundwater samples before and after the pumpdown of retort 1.** Hill, S.L. (Western Research Inst., Laramie, WY (USA)). Sep 1986. Contract FC21-83FE60177. 45p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013439.

In 1984, the Rio Blanco Oil Shale Company received permission from the US Bureau of Land Management/Oil Shale Projects Office to proceed with retort abandonment activities at its Tract C-a modified in situ retort site. One of the first abandonment activities undertaken was to flood the retort with groundwater to dissolve soluble contaminants associated with the retorting operation. Saline water was then pumped from the retort into evaporation ponds during two pumpdown operations in May of 1985 and June of 1986. The principal objective of the pumpdown operations was to remove contaminated groundwater from the retort area and to prevent the migration of contaminants beyond the retort. A toxicological evaluation of groundwaters collected from within the retort and outside the retort is currently in progress. Acute and chronic toxicity tests have been performed using the freshwater invertebrate Ceriodaphnia affinis/dubia with groundwater samples collected before and after the first pumpdown of the retort. The objectives of these tests have been to evaluate the success of the pumpdown operation, to assess the effect of the pumping operations on groundwater quality both within and outside the retort, and to

evaluate the toxicity of groundwater within the retort relative to local groundwater that has not been affected by the retorting operation. This report presents the results of toxicity tests performed before and after the first pumpdown operation. Additional toxicity tests are planned for samples collected after the second pumpdown operation. 15 refs., 2 figs., 9 tabs.

05 NUCLEAR FUELS

40479 (CONF-870822—4) The nuclear fuel cycle: Reminiscences, observations and expectations. Wymer, R.G. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012543.

From American Institute of Chemical Engineers summer national meeting; Minneapolis, MN, USA (16 Aug 1987).

The author discusses his involvement in the nuclear business and gives a personal perspective on nuclear energy, especially the nuclear fuel cycle.

40480 (IAEA-TECDOC—408) Nuclear Fuel Cycle Information System. An international directory of nuclear fuel cycle facilities prepared at the International Atomic Energy Agency. (International Atomic Energy Agency, Vienna (Austria)). Feb 1987. 123p. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702736.

The Nuclear Fuel Cycle Information System (NFCIS) is an international directory of civilian nuclear fuel cycle facilities. Its purpose is to identify existing and planned nuclear fuel cycle facilities throughout the world and to indicate their main parameters. It includes information on facilities for uranium ore processing, refining, conversion and enrichment, for fuel fabrication, away-from-reactor storage of spent fuel and reprocessing, and for the production of zirconium metal and Zircaloy tubing. NFCIS currently covers 271 facilities in 32 countries and includes 171 references.

0501 Reserves, Exploration, And Mining

REFER ALSO TO CITATION(S) 41949

40481 (INIS-BR—658) Production of radiogenic heat in the Pocos de Caldas alkaline massif (MG, SP, Brazil), a new evaluation. Rocha, E.B.; Fujimori, K. (Sociedade Brasileira de Geofisica, Rio de Janeiro). 1985. 1p. (In Portuguese). (CONF-8511295—5-Summ.). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702766.

From 1. regional meeting of geophysics; Sao Jose dos Campos, Brazil (27 Nov 1985).

Published in summary form only.

40482 (INIS-BR—662) Serra do Carambei Granite - PR and the uraniferous anomalism. Pinto-Coelho, C.V. (Brasilia Univ. (Brazil). Dept. de Geociencias). 1986. 329p. (In Portuguese). NTIS (US Sales Only), PC A15/MF A01. File Number DE87702770.

It include maps.

The Serra do Carambei Granite forms a pluton relatively homogeneous, covering about 33 km², cropping out as an elongate retangular body trending NE-SW, being emplaced in the Cunhaporanga Granitoid Complex. Its characteristics indicates a kind of hololeucocratic granite, equigranular, medium to coarse-grained, consisting predominantly of microperthitic alkali-feldspar, quartz and a small amount of biotite (less than 1%), thus being classified as an alaskite. Chemical data allows a classification in the group of granite with high contents of silica (74-76% Wt. SiO_2), dominantly alkaline chemism and hypersolvus character, derived from a parental magma under saturated in water with distinguished features of granitoids from the magnetite series and types I and A granites. The pluton shows important chemical variations due to weathering processes. However detailed chemical studies reveal the presence of anomalous concentrations of trace elements such as U, Sn, Nb, Y, Zr, the Serra do Carambei Granite lacks economically important mineralizations because of the absence of well-developed tardi/posmagmatic processes that could concentrate them. The SW side of the granite is cut by leucocratic rhyolite dykes that show some radiometric anomalies. These rocks, which are highly diferentiated, were emplaced contemporaneously to the Serra do Carambei Granite. Although petrographic and chronological similarities are found between the uraniferous alaskite of Roessing (Namibia) and the Serra do Carambei Granite anyhow it was not possible to establish any lateral continuity with the uranifeous Pan-African Province.

40483 (INIS-XN—55) Uranium, resources, production and demand. Statistical update 1986. (Nuclear Energy Agency, 75 - Paris (France)). 1986. 12p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702801.

Periodic assessments of world uranium supply have been conducted by the OECD Nuclear Energy Agency (NEA) and the International Atomic Energy Agency (IAEA) since the mid 1960s. Published every two years, the report Uranium resources, production and demand, commonly referred to as the red book, has become an essential reference document for nuclear planners and policy makers in the international nuclear community. The latest red book, published in 1986, was based on data collected mainly in early 1985. Most of the data for 1985 were therefore provisional. The statistical update 1986 provides updated 1985 data collected in 1986 and provisional data for 1986. This is the first time such an annual update of key Red Book statistical data has been prepared. This year it covers only OECD countries with a secretariat estimate for the rest of Woca.

0505 Uranium Enrichment

REFER ALSO TO CITATION(S) 41482

40484 (POEF-T—3452) Field calibration of new (1984) shielded neutron detectors for uranium deposit estimates in the cascade. Lewis, K.D. (Martin Marietta Energy Systems, Inc., Portsmouth, OH (USA). Quality and Technical Services Div.). 11 Jun 1987. Contract AC05-76OR00001. 44p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013087.

A study has been performed to determine the applicability of the graphs of Operating Method CN 8.3 to estimate uranium masses in process equipment from neutron measurements made with two of four recently constructed (1984) shielded neutron detectors. The study consisted of reconstructing the previously used (1970 to 1984) shielded neutron detector, and then using this reference detector together with a new detector to take neutron count rate measurements of 22 containers of uranium hexafluoride (UF_6) of known assays and masses. For these tests, container sizes varied from 12-inch diameter cylinders to 2S-sized cylinders, uranium masses ranged from hundred-gram to hundred-kilogram quantities, and U-235 assays varied between 2.1 and 97.3%. In addition, studies were conducted with a Cf-252 neutron source to determine the relative sensitivity of both the reference shielded detector and the new shielded detector to neutrons. A second series of measurements were performed with a cart-mounted portable "SNAP" neutron detector (manufactured by National Nuclear Corporation) on the same UF_6 cylinders to establish the general guidelines for using this instrument to determine whether unsafe quantities of uranium materials have accumulated in cascade equipment. The test results indicate that the graphs may be used to reasonably and conservatively estimate uranium masses using a new correction factor applied to field measurements made with the new series of shielded neutron detectors. Experimental results also produced guideline criteria for field estimates of uranium masses using the mobile SNAP neutron detector.

40485 (UCID—20595) Real-time graphic displays in Mars. Treadway, T. (Lawrence Livermore National Lab., CA (USA); General Electric Co., San Jose, CA (USA)). 1 Dec 1985. 17p. NTIS, PC A02. File Number DE87013570.

Real-time diagnostic data of the AVLIS process is displayed in the form of a two-dimensional plot on selected monitors in the Mars Control Room. Each Mars workstation contains a HP2622 terminal for computer interface to the experiment and a Raster Technologies graphic controller driving a Conrac high resolution color monitor for graphics output.

0507 Fuels Production And Properties

REFER ALSO TO CITATION(S) 40487, 40603, 40929

40486 **Remote visual inspection of nuclear fuel pellets with fiber optics and video image processing.** Moore, F.W. (Westinghouse Hanford Co., Hanford Engineering Development Lab., P.O. Box 1970, Richland, WA 99352). *Optical Engineering;* **26**: No. 2, 152-155(Feb 1987). Contract AC06-76FF02170.

Westinghouse Hanford Company has designed and constructed a nuclear fuel fabrication process line for the U.S. Department of Energy. This process line includes a system that remotely inspects the cylindrical surface of nuclear fuel pellets for surface spots, flaws, or discoloration. The pellets are inspected on a 100% basis after pellet sintering. A feeder delivers the pellets directly to a fiber optic inspection head, which views one pellet surface at a time and images it to a closed-circuit color television camera (CCTV). The output signal of the CCTV is input to a digital imaging processor that stores approximately 25 pellet images at a time. A human operator visually examines the images of the pellet surfaces on a high resolution monitor and accepts or rejects the pellets based on visual standards. The operator uses a digitizing tablet to record the location of rejected pellets, which are then automatically removed from the product stream. The system is expandable to automated disposition of the pellet surface image.

0508 Spent Fuels Reprocessing

REFER ALSO TO CITATION(S) 40562, 40611, 40662, 41458, 41471, 41492

40487 **(CONF-870801—2) Concept for a small, colocated fuel cycle facility for oxide breeder fuels.** Burch, W.D.; Stradley, J.G.; Lerch, R.E. (Oak Ridge National Lab., TN (USA); Hanford Engineering Development Lab., Richland, WA (USA)). 1987. Contract AC05-84OR21400. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011934.

From International conference on nuclear fuel reprocessing and waste management; Paris, France (24 Aug 1987).

As part of a United States Department of Energy (USDOE) program to examine innovative liquid-metal reactor (LMR) system designs over the past three years, the Oak Ridge National Laboratory (ORNL) and the Westinghouse Hanford Company (WHC) collaborated on studies of mixed oxide fuel cycle options. A principal effort was an advanced concept for a small integrated fuel cycle colocated with a 1300-MW(e) reactor station. The study provided a scoping design and a basis on which to proceed with implementation of such a facility if future plans so dictate. The facility integrated reprocessing, waste management, and refabrication functions in a single facility of nominal 35-t/year capacity utilizing the latest technology developed in fabrication programs at WHC and in reprocessing at ORNL. The concept was based on many years of work at both sites and extensive design studies of prior years.

40488 **(EUR—8372) Precise determination of magnesium and lutetium in input accountability tank solutions of nuclear reprocessing plants by the mass spectrometric stable isotope dilution technique.** Trincherini, P.R.; Mousty, F.; Pfeiffer, W. (Commission of the European Communities, Ispra (Italy). Joint Research Centre; Commission of the European Communities, Luxembourg). 1986. 21p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87752264.

This paper describes the procedures for the determination of Mg and Lu concentrations in input solutions of nuclear fuel dissolved in reprocessing plants. The main aim of this work is to supply an independent method for measuring the volume of input accountability tanks. The methods used include suitable radiochemical separations and isotope dilution mass spectrometric measurements. Chemical separations from highly radioactive solutions have been tested in order to obtain pure and "cold" samples of Mg and Lu to be measured by Mass Spectrometry. Different ionisation techniques have been used in obtaining precise isotopic ratios. Results are presented and compared with historical data. A critical evaluation of methods, results and apparatus is given. 17 refs.

40489 **(LA—10906) Improved recovery and purification of plutonium at Los Alamos using macroporous anion exchange resin.** Marsh, S.F.; Mann, M.J. (ed.). (Los Alamos National Lab., NM (USA)). May 1987. Contract W-7405-ENG-36. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010648.

For almost 30 years, Los Alamos National Laboratory has used anion exchange in nitric acid as the major aqueous process or the recovery and purification of plutonium. One of the few disadvantages of this system is the particularly slow rate at which the anionic nitrato complex of Pu(IV) equilibrates with the resin. The Nuclear Materials Process Technology Group at Los Alamos recently completed an ion exchange development program that focused on improving the slow sorption kinetics that limits this process. A comprehensive investigation of modern anion exchange resins identified porosity and bead size as the properties that most influence plutonium sorption kinetics. Our study found that small beads of macroporous resin produced a dramatic increase in plutonium process efficiency. The Rocky Flats Plant has already adopted this improved ion exchange technology, and it currently is being evaluated for use in other DOE plutonium-processing facilities.

40490 **(RCM—01184) Faster dissolution of PuO/sub 2/ in nitrous media by means of electrolytic oxidation.** Baumgaertner, F.; Kim, J.I.; Luckner, N.; Brueckl, N.; Lieberer, E. (Technische Univ. Muenchen, Garching (Germany, F.R.). Lehrstuhl fuer Radiochemie). Mar 1984. 15p. (In German). NTIS, PC E07; Available from NTIS as TIB/B87-07806.

The contribution shows that the dissolution of PuO/sub 2/ in HNO/sub 3/ can be accelerated considerably by means of electrolytic oxidation. A glass apparatus has been developed which uses platinum electrodes providing for sufficient contact between electrodes and solids. Increase of temperature, acid concentration, and electrode current density, and a good contact between electrode and metal oxide will improve the dissolution kinetics. The reaction could be made even faster by addition of Ce/sup 4+/.

40491 **(RCM—01886) Studies on interfacial precipitation of the first PUREX extraction cycle.** Baumgaertner, F.; Huber, A. (Technische Univ. Muenchen, Garching (Germany, F.R.). Lehrstuhl fuer Radiochemie). Sep 1986. 9p. (CONF-860921—8). NTIS (US Sales Only), PC A02/MF A01. File Number DE87751895.

From ISEC '86: international solvent extraction conference; Munich, F.R. Germany (11 Sep 1986).

For the study of solids in nuclear fuel solutions 14 g of LWR-fuel with a burnup of 45,000 MWd/tU have been dissolved in 7M HNO/sub 3/. The fuel has been irradiated for 4 years and cooled down for 2.4 years. The solids in the solution were removed by 4 consecutive filtration steps with nuclepore-filters of 1 μm poresize after 2.5, 20, 68 and 164 hours. The filter residues were characterized by X-ray microanalysis in a scanning electron microscope, equipped for the analysis of highly radioactive materials.

40492 **(RFP—4030) Production-scale plutonium-neptunium separation and residue recovery at Rocky Flats Plant.** Martella, L.L.; Guyer, R.H.; Leak, W.C.; Thomas, R.L. (eds.). (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 26 May 1987. Contract AC04-76DP03533. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013420.

An anion exchange process to recover plutonium from plutonium - 0.5% neptunium residues has been investigated on a production scale. The plutonium was effectively recovered and separated from neptunium using Rohm and Haas Amberlite IRA-938 (20 to 50 mesh) macroreticular anion exchange resin. During this process, 58.3 kg of plutonium containing less than 100 μg Np/g Pu has been recovered.

0509 Transport And Storage

REFER ALSO TO CITATION(S) 40658, 40659, 40672, 41368

40493 (DOE/OR/00033—T321) Sources of transportation expertise by selected technical areas. (Oak Ridge Associated Universities, Inc., TN (USA)). 5 Jun 1987. Contract AC05-76OR00033. 44p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012454.

The US Department of Energy (DOE), Office of Civilian Radioactive Waste Management (OCRWM) has assigned components of its Waste Transportation Program to three of the DOE Operations offices. The DOE Oak Ridge Operations Office (ORO) is responsible for the transportation operations design, development, acquisition, testing, implementation, and program management, including the equipment, facilities, and services of the transportation system. Within ORO, the OCRWM transportation component is assigned to the Transportation Operations Project Office (TOPO). The specific activities involved in the ORO/TOPO include procurement, operational testing, inspection, logistics, interfaces, maintenance, management and improvements, and system operation. Oak Ridge Associated Universities (ORAU) has developed (and will maintain and enhance) a data base of sources of transportation expertise in selected technical areas for ORO. The data base includes individuals and organizations who have indicated that they have capabilities and interest in assisting ORO in the design, development, implementation, and management of the OCRWM transportation system. This assistance might be in the form of consulting or subcontract work and/or participation in peer review panels, technical evaluation committees, workshops, advisory groups, etc. This initial project was completed in the four month period of January 30, 1987 through May 31, 1987.

40494 (EPRI-NP—5268) The MC-10 PWR spent fuel storage cask: Testing and analysis. McKinnon, M.A.; Creer, J.M.; Wheeler, C.L.; Tanner, J.E.; Batalo, D.P.; Dziadosz, D.A.; Moore, E.V.; Schooner, D.H.; Jensen, M.F.; Browder, J.H. (Pacific Northwest Lab., Richland, WA (USA); Virginia Power Co., Richmond (USA); EG and G Idaho, Inc., Idaho Falls (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jul 1987. Contract AC07-76ID01570. 242p. NTIS, PC A11/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303; 1; GPO Dep. File Number DE87012614.

A Westinghouse MC-10 pressurized water reactor (PWR) spent fuel storage cask was performance-tested. The performance test consisted of loading the MC-10 cask with 24 PWR spent fuel assemblies from Virginia Power's Surry reactor. Cask surface and fuel assembly guide tube temperatures, as well as cask surface gamma and neutron dose rates, were measured. Testing was performed with vacuum, nitrogen, and helium backfill environments in both vertical and horizontal cask orientations. Limited spent fuel integrity data were also obtained. Results of the performance test indicate that, when dissipating 12.6 kW, the MC-10 cask exhibited exceptionally good heat transfer performance. Maximum measured assembly guide tube temperatures in vacuum, nitrogen, and helium backfills in a vertical cask orientation were 212, 172, and 134°C, respectively. Significant convection heat transfer was present in the vertical nitrogen run, and a lesser effect was observed in the vertical helium test run, as indicated by peak temperatures occurring in the upper regions of the fuel assemblies. Pretest temperature predictions of the COBRA-SFS heat transfer computer code were in good agreement with test data, and post-test predictions agreed exceptionally well (30°C) with data. Cask surface gamma and neutron dose rates were measured to be less than the design goal of 68 mrem/h except on the bottom of the cask where dose rates as high as 85 mrem/h were measured. This dose rate could be reduced by adding more gamma shielding. Dose rates of 50 mrem/h were measured on the side of the cask. It was concluded that, with minor refinements, the MC-10 PWR storage cask can be satisfactorily implemented to safely store spent fuel from both heat transfer and shielding performance perspectives. 35 refs., 111 figs., 16 tabs.

40495 (ORNL/CSD/TM—248) CAPSIZE: A personal computer program and cross-section library for determining the shielding requirements, size, and capacity of shipping casks subject to various proposed objectives. Bucholz, J.A. (Oak Ridge National Lab., TN (USA)). May 1987. Contract AC05-84OR21400. 120p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87013188.

A new interactive program called CAPSIZE has been written for the IBM-PC to rapidly determine the likely impact that proposed design objectives might have on the size and capacity of spent fuel shipping casks designed to meet those objectives. Given the burnup of the spent fuel, its cooling time, the thickness of the internal basket walls, the desired external dose rate, and the nominal weight limit of the loaded cask, the CAPSIZE program will determine the maximum number of PWR fuel assemblies that may be shipped in a lead-, steel-, or uranium-shielded cask meeting those objectives. The necessary neutron and gamma shield thicknesses are determined by the program in such a way as to meet the specified external dose rate while simultaneously minimizing the overall weight of the loaded cask. The one-group cross-section library used in the CAPSIZE program has been distilled from the intermediate results of several hundred 1-D multigroaup discrete ordinates calculations for different types of casks. Neutron and gamma source terms, as well as the decay heat terms, are based on ORIGEN-S analyses of PWR fuel assemblies having exposures of 10, 20, 30, 40, 50, and 60 gigawatt days per metric tonne of initial heavy metal (GWD/MTIHM). In each case, values have been tabulated at 17 different decay times between 120 days and 25 years. Other features of the CAPSIZE program include a steady-state heat transfer calculation which will minimize the size and weight of external cooling fins, if and when such fins are required. Comparisons with previously reported results show that the CAPSIZE program can generally estimate the necessary neutron and gamma shield thicknesses to within 0.16 in. and 0.08 in., respectively. The corresponding cask weights have generally been found to be within 1000 lbs of previously reported results. 13 refs., 20 figs., 54 tabs.

40496 (SAND—87-1174C) Benchmarking computer codes for cask development. Glass, R.E. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 5p. (CONF-870713—36). NTIS, PC A02. File Number DE87012733.

From 28. INMM annual meeting on safeguards: a mature technology; Newport Beach, CA, USA (12 Jul 1987).

Sandia National Laboratories has taken the lead in developing a series of standard problems to evaluate structural and thermal computer codes used in the development of nuclear materials packagings for the United States Department of Energy (DOE). These problems were designed to simulate the hypothetical accident conditions given in Title 10 of the Code of Federal Regulation, Part 71 (10CFR71) while retaining simple geometries. This problem set exercises the ability of the codes to model pertinent physical phenomena without requiring extensive use of computer resources. The development of the standard problem set has involved both national and international consensus groups. Nationally, both the problems and consensus solutions have been developed and discussed at Industry/Government Joint Thermal and Structural Code Information Exchange meetings. Internationally, the Organization for Economic Cooperation and Development (OECD), through its Nuclear Energy Agency's Committee on Reactor Physics, has hosted a series of Specialists' Meetings on Heat Transfer to develop standard thermal problems and solutions. Each of these activities is represented in the standard problem set and the consensus solutions. This paper presents a brief overview of the structural and thermal problem sets. 15 refs.

40497 (SAND—87-1864C) Measurements in high intensity fires. Keltner, N.R.; Bainbridge, B.L.; Kent, L.A.; Schneider, M.E. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 4p. (CONF-870649—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012373.

From American Society for Testing and Materials; Cincinnati, OH, USA (21 Jun 1987).

Sandia National Laboratories utilizes fire test facilities to subject military components and nuclear material shipping contain-

ers to postulated accident environments. Understanding and simulating the fire environment found in a severe accident is a complex problem. While there is no concensus as to the appropriate definition of the fire environment, there are two general approaches for defining the minimum thermal exposure. One that is typically used with furnaces involves defining a fire temperature history, e.g., ASTM E-119; the other is to define the heat transfer rate to a surface in terms of the relative temperatures of the surface and the fire. Measurements of heat transfer in a fire and to an object engulfed by the fire are very difficult to make. In general, heat flux sensors are more expensive and less robust than temperature sensors. In the fire test facilities operated by Sandia National Laboratories, a variety of heat flux measurements have been made. These measurements have used circular foil heat flux gages for both total and radiative fluxes, transpiration radiometers, and thermal capacitance calorimeters of several designs. Because the physical size and the thermal mass of the test unit affects the heat transfer to the unit, some of the calorimeters have been designed to represent the physical size and shape of a proposed test item and to have a similar thermal capacitance. This approach provides data for direct comparison with fire test specifications. It can be used to make direct performance comparisons of thermal protection materials.

40498 **Overview of spent fuel management options: Technology and cost.** Beeman, G.H. (Pacific Northwest Lab., Richland, WA 99352). pp 1-14 of The high level waste business, transportation, storage and disposal. Bethesda, MD; Atomic Industrial Forum (1986). (CONF-861032—). Contract AC06-76RL01830.

From High level waste business: transportation, storage and disposal; Charleston, SC, USA (19 Oct 1986).

The options for spent fuel management discussed in this paper. There are several spent fuel management options available to utilities beyond the traditional options of reracking and transshipment. Two different dry storage options have been licensed by NRC and it appears that NRC will issue a license amendment to allow for the storage of consolidated spent fuel in the very near future. The use of either of these spent fuel management options is highly dependent upon the individual requirements of the utility. There are several factors that must be considered when choosing a specific fuel management option. Either of these spent fuel management options, dry storage or rod consolidation, is capable of meeting the needs of utilities for additional spent fuel storage until DOE begins accepting spent fuel for final disposal in 1998.

40499 **The DOE transportation strategy: Public information, communications network and issue resolution.** Philpott, R.E. (Transportation Programs, Office of Civilian Radioactive Waste Management, U.S. Dept. of Energy). pp 1-10 of The high level waste business, transportation, storage and disposal. Bethesda, MD; Atomic Industrial Forum (1986). (CONF-861032—).

From High level waste business: transportation, storage and disposal; Charleston, SC, USA (19 Oct 1986).

The OCRWM plans to issue a draft "comprehensive transportation plan" in the fall of 1987 that combines the Institutional Plan, the Transportation Business Plan (DOE/RW-0046, January 1986), and a framework for transportation operational procedures. This paper reviews the major elements of the OCRWM's institutional strategy. The OCRWM's strategy for addressing transportation issues relies on the development of public information to foster public understanding and acceptance of program activities and goals, and active communication and interaction with all parties having an interest in the development and operation of the NWPA transportation program. The OCRWM's goal in conducting such activities is to foster cooperative effort in addressing transportation issues, and to focus on communication and constructive interaction rather than conflict.

0520 Waste Management

REFER ALSO TO CITATION(S) 40487, 40612, 40613, 40614, 40615, 40616, 40617, 40618, 40619, 40620, 40621, 40622, 40623, 40624, 40625, 40626, 40627, 40628, 40629, 40630, 40631, 40632, 40633, 40634, 40635, 40636, 40637, 40638, 40639, 40640, 40641, 40642, 40643, 40644, 40645, 40646, 40647, 40648, 40649, 40650, 40656, 40657, 40660, 41013, 41302, 41322, 41372, 41450, 41457, 41467, 41470, 41976, 42300

40500 **(DOE/CH—10140-05-87) Bibliography of studies for the Salt Repository Project Office of the Civilian Radioactive Waste Management Program, April 1978-December 1986.** (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). Jun 1987. Contract AC02-83CH10140. 330p. NTIS, PC A15/MF A01; 1; GPO Dep. File Number DE87012850.

This document is an annotated bibliography of approved reports that have been produced for the US Department of Energy Salt Repository Project Office of the Civilian Radioactive Waste Management Program since April 1978. This document is intended for use by the US Department of Energy, State and local officials, the US Nuclear Regulatory Commission, contractors to the Office of Nuclear Waste Isolation, concerned citizens, and others who need a comprehensive listing of reports related to a nuclear waste repository in salt. This document consists of a main report listing, appendixes with Work Breakdown Structure lists, and a topical index.

40501 **(DOE/RW—0020-Rev.6/87) Nuclear Waste Fund fee adequacy: An assessment: Nuclear Waste Policy Act.** (USDOE Office of Civilian Radioactive Waste Management, Washington, DC). Jun 1987. 17p. OSTI, PO Bx 62, Oak Ridge, TN 37831; 1; GPO Dep. File Number DE87011692.

The estimated long-term impact of the costs and fees associated with disposal of defense high-level wastes (DHLW) in the Office of Civilian Radioactive Waste Management (OCRWM) repository system is assessed. It is assumed that the DHLW disposal fees paid will provide funds equivalent to the OCRWM costs for disposing of this waste, including interest on costs incurred before the payment of the fee(s) to cover these costs, and the appropriate share of the common costs of the OCRWM waste disposal system. The DHLW disposal fee payments into the Nuclear Waste Fund will be subject to Congressional appropriations. This report is based on the assumptions that the first repository will open in 2003 and the second repository in 2023. In addition, this analysis features an Improved Performance System (IPS), a major component of which is a proposed (but currently unauthorized) Monitored Retrievable Storage (MRS) facility that is assumed to open in 1998. The possibility of adverse developments in inflation and real interest rates should be considered in assessing the findings of this analysis which are based on a cash flow analysis that utilized methods very similar to those employed in previous fee adequacy studies. Revisions were made in the areas of system logistics, repository schedules, real interest rates, inflation rates, and the estimation of costs for design and evaluation work, transportation, and repositories in differing host rocks. The principal recommendation is that the ongoing disposal fee should remain at 1.0 mill per (net) kilowatt-hour (kWh) for 1987 based on the assumption that defense waste fees will be adequate to cover the defense share of the program costs.

40502 **(DP—1742) Implications of one-year basalt weathering/reactivity study for a basalt repository environment.** Pine, G.L.; Jantzen, C.M. (Savannah River Lab., Aiken, SC (USA)). Mar 1987. Contract AC09-76SR00001. 61p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87012849.

The Savannah River Laboratory is testing the performance of the Defense Waste Processing Facility glass under conditions representing potential repository environments. For a basalt repository, one of the important issues is how rapidly reducing conditions are re-established after placement of the waste. The objective of this study was to examine the factors affecting the reactivity of the basalt. Construction of a nuclear waste repository in basalt will temporarily perturb the groundwater conditions, creating more oxidizing (air-saturated) conditions than an undisturbed repository system. Reducing conditions can be beneficial to the performance

of waste glass and canisters, and may limit the transport of certain radionuclides. The Basalt Waste Isolation Project intends to use a backfill containing crushed basalt to re-establish the reducing conditions of the groundwater. The reactivity of the basalt has been found to be minimal once the fresh crushed surfaces have been weathered and the reactive intergranular glass component has been leached, e.g., by long-term surface storage. Crushing of the basalt for pneumatic emplacement of the backfill should, therefore, occur shortly before placement in the repository. This backfill must contain a minimum of 5 percent reactive fines (<100 mesh), to rapidly achieve reducing conditions. 23 refs., 21 figs., 18 tabs.

40503 **(DP-MS—86-197) An overview of the DWPF [Defense Waste Processing Facility] and a discussion of its unique technology.** Knight, J.R.; Boersma, M.D.; Mahoney, J.L. (Savannah River Lab., Aiken, SC (USA)). 1987. Contract AC09-76SR00001. 7p. (CONF-870801—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012944.

From International conference on nuclear fuel reprocessing and waste management; Paris, France (24 Aug 1987).

The Savannah River Plant has been operating a full nuclear fuel cycle since the early 1950's. Uranium is recycled and fission products and contaminated chemical wastes are sent to waste storage. During the thirty years of operation, about 270 million liters of high level radioactive waste have been generated. The Defense Waste Processing Facility (DWPF) presently under construction at Savannah River will process this waste into a borosilicate glass form suitable for long-term geologic disposal. The purpose of this paper is not to present a detailed description of the DWPF, but rather to highlight certain unique features of the DWPF process. The waste is presently stored in alkaline form in 5-million-liter carbon steel tanks. The stored waste exists in three forms: sludge, salt cake, and saturated salt solution. Most of the radioactive components are in the sludge; the principal exception is ^{137}Cs which is in both salt cake and supernate. Although the choice of borosilicate glass for high level waste disposal has been accepted in many countries, a number of factors including specific waste chemistry, existing facilities, operating philosophy, etc., have led to a number of design features that are unique to the DWPF and that represent novel approaches either for Savannah River or for the nuclear industry as a whole. 3 refs., 6 figs.

40504 **(DP-MS—87-16) Air-lift sampling system for hazardous liquids.** Beasley, D.E.; Liburdy, J.A. (Clemson Univ., SC (USA). Dept. of Mechanical Engineering). [1987]. Contract AC09-76SR00001. 18p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87011238.

Sampling hazardous liquids, such as radioactive solutions, and toxic or corrosive materials present unique constraints for the design of a sampling system. The subject of the current study is the analysis of an air-lift sampling system for transporting a liquid sample from a lower elevation to a remote sampling location. A steady model of the operation of the sampling is proposed which identifies the parameters important to system design and operation. The sampling system, operating under vacuum conditions, can provide a prescribed liquid flow and allow for the effective sampling of a hazardous liquid in a safe manner.

40505 **(EUR—10384) Conditioning of waste cladding hulls by embedding in metallic materials and graphit matrix.** Schmidt-Hansberg, T. (Commission of the European Communities, Luxembourg). 1986. 38p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE87752265.

The embedding of spent fuel hulls and dissolution residues requires an extremely corrosion, leach, and radiation resistant as well as mechanically and thermally stable matrix material. With due regard to these requirements five materials were selected for technical scale tests: . graphite/sulfur (80 w% graphite, 20 w% sulfur), . graphite/nickel sulfide (43.7 w% graphite, 41.3 w% nickel, 15 w% sulfur), . aluminium (99.99 w% Al), . AlSi12 alloy (85 w% Al, 12 w% Si), and AlMg3Si alloy (94 w% Al, 3 w% Mg, 1 w% Si). On account of the fabrication process, the core loading, the physical properties and the leach and corrosion resistance graphite/sulfur and Al 99.99 were judged to be the most promising embedding materials for hulls and dissolution residues. Both materials have been selected for further research and development activities with high level waste.

40506 **(EUR—10392) Research on heat induced water liberation from rock salt with polyhalite in situ. Temperature test 5 at Asse salt mine.** Rothfuchs, T. (Commission of the European Communities, Luxembourg). 1986. 99p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE87752266.

The temperature Test 5, which was begun in April 1982 to investigate the geological boundary conditions at heating of rock salt formations, was shut down according to schedule in February 1983 at termination of the 5th heating step. The test was carried out in the rock salt with polyhalite seams Na2P at the 775 m level of the Asse salt mine. Polyhalite K/sub 2/Ca/sub 2/Mg(SO/sub 4/)/ sub ./42H/sub 2/O contains crystalline water and may also be found in small quantities in the Older Halite Na2β, which is considered to be a suitable disposal medium. In order to investigate the temperature dependent start of the liberation of crystalline water, i.e., the decomposition of polyhalite in situ, the rock salt was heated stepwise to 100/sup 0/C, 150/sup 0/C, 200/sup 0/C, 230/sup 0/C and 270/sup 0/C. The heaters were placed in a 7 m deep horizontal borehole. Apart from the initially high liberation rates in heating step 1, the highest liberation rates were registered in heating step 5 due to the original liberation of adsorptive water bound to the borehole wall. This was found to be a reference to the beginning of crystalline water liberation above 230/sup 0/C. Extensive chemical/mineralogical analyses on heated rock salt were carried out in 1984. The immediate surroundings of the heaters, showed partly decomposed polyhalite crystals. A detailed temperature analysis showed that such decomposed crystals were only found in salt samples taken from areas which had temperatures higher than 230/sup 0/C. Hereby it could be proved that the decomposition of polyhalite is negligible at 200/sup 0/C.

40507 **(EUR—10516) Decontamination of fast reactor hulls and properties of immobilised waste forms.** Biddle, P.; Brown, P.E.; Rees, J.H. (Commission of the European Communities, Luxembourg). 1986. 92p. NTIS (US Sales Only), PC A05/MF A01. File Number DE87752267.

The studies described in this Report have been carried out on five batches of stainless steel hulls resulting from the reprocessing of fuel from the Prototype Fast Reactor at Dounreay. Direct immobilisation in cement and decontamination have been examined as possible routes for treating the hulls. A number of low temperature chemical techniques have been used to remove actinides and fission products from the hulls. The levels of α-activity could be reduced to less than 0.3 Ci/te of hulls. Thus decontamination might permit cheaper disposal than would be the case for undecontaminated hulls. 10mm sections of hulls have been immobilised in two cements in which either sand or blast furnace slag was used to extend the ordinary Portland cement. The level of Cs-137 leached from hulls immobilised in either of the cement compositions was about an order of magnitude lower than that leached from the bare hulls. For Sr-90, the BFS/OPC matrix gave a tenfold better retention than the sand/OPC. Ru-106 and Sb-125 were leached from the sand/OPC but not from the BFS/OPC samples. The preliminary studies suggested that cement was a satisfactory matrix for immobilising hulls and that the BFS/OPC was the better formulation. 30 refs, 26 tabs, 23 figs.

40508 **(EUR—10579) Characterization of low and medium-level radioactive waste forms. Final report - 2nd Programme 1980-1984.** Pottier, P.E.; Glasser, F.P. (eds.). (Commission of the European Communities, Luxembourg). 1986. 289p. NTIS (US Sales Only), PC A13/MF A01. File Number DE87752269.

The European Communities Second R and D Programme 1980-1984 'Management and Disposal of Radioactive Waste (Shared cost action)' included a closely coordinated research activity for the 'Characterization of low and medium-level radioactive waste forms'. This report summarizes the main results obtained during the five years of the programme by laboratories in seven European countries participating in the coordinated R and D efforts. Ten reference waste forms have been selected, based on the most important types of low and medium-level waste arisings and the three commonly used immobilization matrices: cement, bitumen and polymers. The investigated properties were mainly: waste-matrix com-

patibility, radiation effects, leaching behaviour, leached radionuclides speciation, microbiological resistance and thermal as well as mechanical properties. Extensive experimental results relevant for the qualification of waste products and for application in performance analysis are presented in this final report. The main conclusions are drawn for the confinement properties of these different waste forms. These conclusions have also shown the necessity of selecting several other reference waste forms for the continuation of this RandD action now being launched in the Third EC Programme 1985-1989.

40509 **(EUR—10587) Integral migration and source-term experiments on cement and bitumen waste forms.** Ewart, F.T.; Howse, R.M., Sharpe, B.M.; Smith, A.J.; Thomason, H.P.; Williams, S.J.; Young, M. (Commission of the European Communities, Luxembourg). 1986. 47p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87752270.

This is the final report of a programme of research which formed a part of the CEC joint research project into radionuclide migration in the geosphere (MIRAGE). This study addressed the aspects of integral migration and source term. The integral migration experiment simulated, in the laboratory, the intrusion of water into the repository, the leaching of radionuclides from two intermediate-level waste-forms and the subsequent migration through the geosphere. The simulation consisted of a source of natural ground water which flowed over a sample of waste-form, at a controlled redox potential, and then through backfill and geological material packed in columns. The two waste forms used here were cemented waste from the WAK plant at Karlsruhe in the Federal Republic of Germany and bitumenized intermediate concentrates from the Marcoule plant in France. The soluble fission products such as caesium were rapidly released from the cemented waste but the actinides, and technetium in the reduced state, were retained in the waste-form. The released of all nuclides from the bitumenized waste was very low.

40510 **(EUR—10589-Vol.1) Design solutions to interface flow problems: Text - List of symbols - References.** (Commission of the European Communities, Luxembourg). 1986. 148p. NTIS (US Sales Only), PC A07/MF A01. File Number DE87752262.

All published proposals for the deep level burial of radioactive waste recognise that the access shafts, tunnels and boreholes must be sealed, and that the sealing of these openings plays an integral role in the overall isolation of the waste. Previous studies have identified the interface between the host ground formation and the various sealing materials as potential defects in the overall quality of the waste isolation. The significance of groundwater flow at and near the interface has been assessed for representative conditions in generic repository materials. A range of design options to minimise the significance of flow in the interface zone have been proposed, and the most practical of these options have been selected for quantitative analysis. It has been found that isolated high impermeability collars are of limited value unless a highly effective method of minimising ground disturbance during excavation can be developed. It has also been found that control of radionuclide migration by sorptive processes provides an attractive option. The effect of various geometrical arrangements of sorptive materials has been investigated. Consideration has also been given to the particular conditions in the near field, to the behaviour of weak plastic clay host formations and to the mechanical interaction between the backfill material and the host formation.

40511 **(EUR—10589-Vol.2) Design solutions to interface flow problems. Figures - Tables - Appendices.** (Commission of the European Communities, Luxembourg). 1986. 106p. NTIS (US Sales Only), PC A06/MF A01. File Number DE87752263.

All published proposals for the deep level burial of radioactive waste recognise that the access shafts, tunnels and boreholes must be sealed, and that the sealing of these openings plays an integral role in the overall isolation of the waste. Previous studies have identified the interface between the host ground formation and the various sealing materials as potential defects in the overall quality of the waste isolation. The significance of groundwater flow at and near the interface has been assessed for representative conditions in generic repository materials. A range of design options to minimise the significance of flow in the interface zone have been proposed, and the most practical of these options have been selected for quantitative analysis. It has been found that isolated high impermability collars are of limited value unless a highly effective method of minimising ground disturbance during excavation can be developed. It has also been found that control of radionuclide migration by sorptive processes provides an attractive option. The effect of various geometrical arrangements of sorptive materials has been investigated. Consideration has also been given to the particular conditions in the near field, to the behaviour of weak plastic clay host formations and to the mechanical interaction between the backfill material and the host formation.

40512 **(EUR—10619) Retardation of radionuclide transport by fracture flow in granite and argillaceous rocks.** Bradbury, M.H.; Green, A. (Commission of the European Communities, Luxembourg). 1986. 38p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87752271.

This work focused on the study of diffusion of solutes into the pores of hard rock matrix as a potential retardation mechanism for radionuclides migrating through the geosphere. The following factors were investigated: (a) pore connectivity; (b) weathering effects at the surface of fissures; (c) role of confining pressure; (d) penetration of latex colloids into the pores; (e) comparison of diffusion coefficients of various granite samples and of indurated argillaceous material. This work was carried out in the framework of the CEC Mirage project on migration of radionuclides in the geosphere.

40513 **(EUR—10702) Conditioning of waste cladding hulls by eutectic melting and embedding in glass.** Mazoyer, R.; Vernaz, E. (Commission of the European Communities, Luxembourg). 1986. 64p. (In French). NTIS (US Sales Only), PC A04/MF A01. File Number DE87752272.

Radioactive zircaloy fuel cans were compacted by eutectic melting with copper. Decontamination of molten metal with a low melting point fluorinated slag was studied. Tritium release was also measured. Zircaboy fuel cans were embedded in glass by heating under argon atmosphere. Block obtained are monolithic and compact. Leaching ratio of metallic ingots are relatively high at ambient temperature, probably by galvanic corrosion due to copper. However alpha activity is lower than activity from conditioned wastes. Containment is poor for embedded wastes during first days of leaching due to the preparation process.

40514 **(EUR—10703) Polymer and bitumen-modified OPC for the immobilization of ILW.** Johnson, D.I.; Worrall, G.; Phillips, D.C. (Commission of the European Communities, Luxembourg). 1986. 66p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87752273.

A detailed study has been made of the modification of ordinary Portland cement with polymeric additives, and of the properties of waste forms based on these matrix materials. The additives were styrene butadiene and bitumen emulsions, and epoxide and polyurethane resins: the simulated wastes were organic ion exchanger beads, PWR evaporator concentrate, reprocessing concentrate and Magnox metal. The effect of polymer: cement (p:c) and water:cement ratios on the properties of the hardened cement paste has been comprehensively investigated. Substantial increases in strain to failure, and modest reductions in permeability to water and leach rates for Cs/sup 137/, are obtained at p:c $>$ 0.2. Much larger volume fractions of organic ion exchange beads can be encapsulated in polymer modified OPC than in unmodified OPC, perhaps because of their better strain capability. The radiation stability of cemented PWR evaporator concentrate is better for a polymer-modified matrix than an unmodified OPC matrix. Two hundred litre trials have been successfully demonstrated. 20 refs, 20 tabs, 10 figs.

40515 **(IAEA-SR—110, pp 61) Concrete conditioners for low-intermediate level nuclear wastes.** Roehl, J.L.; Franzen, H.R. (Pontificia Univ. Catolica do Rio de Janeiro, Brazil; Comissao Nacional de Energia Nuclear de Brasil, Rio de Janeiro). 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE87702447. (CONF-861065—Absts.).

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

40516 (IAEA-SR—110, pp 83) **Packaging, transportation and interim storage of unconditioned and conditioned wastes.** Baehr, W. (International Atomic Energy Agency, Vienna, Austria). 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE87702447. (CONF-861065—Absts.).

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

40517 (IAEA-SR—110, pp 39) **IEN Low-level radioactive waste management.** Rocha, A.C.S. da; Pina, J.L.S.; Silva, S. da; Silva, J.J.G. (Instituto de Engenharia Nuclear, Rio de Janeiro, Brazil). 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE87702447. (CONF-861065—Absts.).

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

40518 (IAEA-SR—110, pp 65) **Radwaste disposal system analysis for South America conditions.** Castello Branco, A.L.; Brown, A.P.; Leushacke, D.F. (Inter-Uhde, Sao Paulo, Brazil). 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE87702447. (CONF-861065—Absts.).

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

40519 (IAEA-SR—110, pp 82) **IAEA programme for low and intermediate - level waste management.** Saire, D.E.; Baehr, W.; Hirling, J. (International Atomic Energy Agency, Vienna, Austria. Div. of Nuclear Fuel Cycle). 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE87702447. (CONF-861065—Absts.).

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

40520 (IAEA-SR—110, pp 43) **Development and design of a cementation process.** Vicente, R. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, Brazil). 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE87702447. (CONF-861065—Absts.).

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

40521 (IAEA-SR—110, pp 45) **Method for qualification of a cementation process and its application to a vibration mixer.** Vicente, R.; Rzyski, B.M.; Suarez, A.A. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, Brazil). 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE87702447. (CONF-861065—Absts.).

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

40522 (IAEA-SR—110, pp 46) **Facility for low-level solid waste treatment.** Vicente, R.; Miyamoto, H. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, Brazil). 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE87702447. (CONF-861065—Absts.).

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

40523 (IAEA-SR—110, pp 47) **Leaching studies on ion exchange resins immobilized in bitument matrix.** Grosche Filho, C.E.; Chandra, U.; Villalobos, J.P.; Endo, L.S. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, Brazil). 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE87702447. (CONF-861065—Absts.).

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

40524 (IAEA-SR—110, pp 48) **Bituminization of simulated waste, spent resins, evaporator concentrates and animal ashes by extrusion process.** Grosche Filho, C.E.; Chandra, U. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, Brazil). 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE87702447. (CONF-861065—Absts.).

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

40525 (IAEA-SR—110, pp 50) **Design of an evaporator/crystallizer for radioactive liquid waste treatment.** Grosche Filho, C.E.; Dellamano, J.C.; Dalaqua Junior, L. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, Brazil). 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE87702447. (CONF-861065—Absts.).

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

40526 (IAEA-SR—110, pp 52) **Incineration facility for combustible solid and liquid radioactive wastes in IPEN-CNEN - Sao Paulo.** Krutman, I.; Grosche Filho, C.E.; Chandra, U.; Suarez, A.A. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, Brazil). 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE87702447. (CONF-861065—Absts.).

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

40527 (IAEA-SR—110, pp 54) **Volume reduction and toluene recuperation from liquid scintillation waste.** Dellamano, J.C.; Dalagua Junior, L.; Suarez, A.A. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, Brazil). 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE87702447. (CONF-861065—Absts.).

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

40528 (IAEA-SR—110, pp 72) **Leaching of nuclear power reactor waste forms.** Endo, L.S.; Villalobos, J.P.; Miyamoto, H. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, Brazil). 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE87702447. (CONF-861065—Absts.).

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

40529 (IAEA-SR—110, pp 75) **Evaluation of solidified cement waste forms.** Rzyski, B.M.; Suarez, A.A. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, Brazil). 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE87702447. (CONF-861065—Absts.).

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

40530 (IAEA-SR—110, pp 78) **Experience on the operation of a low-level solid waste treatment facility.** Miyamoto, H.; Suarez, A.A.; Vicente, R. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, Brazil). 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE87702447. (CONF-861065—Absts.).

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

40531 (IAEA-SR—110, pp 79) **Conditioning liquid waste from I/sup 131/ production by natural TeO/sub 2/ neutron irradiation.** Dalaqua Junior, L.; Dellamano, J.C. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, Brazil). 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE87702447. (CONF-861065—Absts.).

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

40532 (IAEA-SR—110, pp 80) **Releases and storage of radiaoctive wastes at Angra 1 nuclear power plant.** Kamel, N.H. (Comissao Nacional de Energia Nuclear de Brasil, Rio de Janeiro). 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE87702447. (CONF-861065—Absts.).

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

40533 (IAEA-SR—110, pp 81) **Separation of radionuclides from radioactive waste solutions by chemical precipitation.** Gompper, K. (Kernforschungszentrum Karlsruhe G.m.b.H., Germany, F.R. Inst. fuer Nukleare Entsorgungstechnik). 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE87702447. (CONF-861065—Absts.).

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

40534 (IAEA-SR—110, pp 84) **Argentina experience low and intermediate level radioactive.** Pahissa, M.H. de. (Comision Nacional de Energia Atomica, Buenos Aires, Argentina). 1986. (In Spanish). NTIS (US Sales Only), PC A05/MF A01. File Number DE87702447. (CONF-861065—Absts.).

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

40535 (IAEA-SR—110, pp 40) **Design of a package for encapsulation, transport and final disposal of discarded radium needles.** Villalobos, J.P.; Vicente, R.; Suarez, A.A. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, Brazil). 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE87702447. (CONF-861065—Absts.).

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

40536 (IAEA-SR—110, pp 41) **Design and development of a liquid waste storage tank.** Vicente, R. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, Brazil). 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE87702447. (CONF-861065—Absts.).

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

40537 (IAEA-SR—110, pp 59) **Conceptual design of shallow ground nuclear waste disposal site.** Roehl, J.L.; Franzen, H.R. (Pontificia Univ. Catolica do Rio de Janeiro, Brazil; Comissao Nacional de Energia Nuclear de Brasil, Rio de Janeiro). 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE87702447. (CONF-861065—Absts.).

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

40538 (IAEA-SR—110, pp 68) **Site selection for low and intermediate level radwastes in Brazil.** Castello, A.; Dornelles, G.H.; Martins, L.A.; Pinto, F.J.B.A.; Leao, I.L.B.; Nicolli, D.; Santos, A.A.; Barreto, P.M.C. (Comissao Nacional de Energia Nuclear de Brasil, Rio de Janeiro). 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE87702447. (CONF-861065—Absts.).

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

40539 **(INIS-mf—10934) Central facility for processing and deposition of low- and intermediate-level radioactive waste and deposition of high-level radioactive waste and irradiated fission elements. COVRA's choice.** (Centrale Organisatie voor Radioactief Afval B.V., Petten (Netherlands)). Jun 1986. 42p. (In Dutch). NTIS (US Sales Only), PC A03/MF A01. File Number DE87702800.

The Dutch minister of town and country planning, housing of the people and environmental control has decided that the Dutch Central Organization for Radioactive Waste (COVRA) is permitted to make a selection out of three available areas for deposition of radioactive waste. In this report the available areas are described and mutually compared on some important aspects. The most important criteria of COVRA in the comparison have been: 1) a minimal mutual safety influence between the environment and COVRA settlement. 2) Situation of the area with respect to the surrounding population. 3) Situation of the area with respect to waste transport. 4) An accountable as possible choice with regard to the costprice. 5) Simplicity and unambiguity of the procedure and planning steps to be taken. On account of above considerations COVRA has concluded that the area of the PZEM inc. in the municipality Borsele should be perferred. 3 references, 12 figures.

40540 **(INIS-XN—56) Nuclear spent fuel management. Experience and options.** (Nuclear Energy Agency, 75 - Paris (France)). 1986. 112p. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702802.

Spent nuclear fuel can be stored safely for long periods at relatively low cost, but some form of permanent disposal will eventually be necessary. This report examines the options for spent fuel management, explores the future prospects for each stage of the back-end of the fuel cycle and provides a thorough review of past experience and the technical status of the alternatives. Current policies and practices in twelve OECD countries are surveyed.

40541 **(JINR-R—10-86-124) Program complex for simulating neutron cross sections of transactinium nuclei in unresolved resonance region.** Nefed'eva, L.S.; Mateeva, A.; Tarasova, V.N.; Toshkov, S.; Ukraintsev, V.F.; Yaneva, N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation; Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1986. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702834.

The modernization of the program complex for simulation of neutron cross sections and their functionals in the unresolved resonance region has been performed. The algorithm is based on the Monte Carlo method, on using the distribution function cross section probability density and on comparison of the calculated cross section and transmission values with experimental ones. The program refinement was connected with the necessity of their application as a part of the reactor calculation package. The method for calculation of the cross section detailed energy dependence has been optimized. Now the computer memory requested is significantly smaller. The collision matrix elements are calculated by the $(1 - ik)^{-1}$ matrix without common reversion formulae, but using analytical expressions derived for the unitary matrix of rank three. The computing time for one energy scale point is diminished by a factor of three. The program complex, necessary input information and the result printing are described. 3 references.

40542 **(LBL—23370) Nuclide migration from areal sources into a fracture.** Ahn, J.; Chambre, P.L.; Pigford, T.H.; Lee, W.W.L. (Lawrence Berkeley Lab., CA (USA)). Apr 1987. Contract AC03-76SF00098. 9p. (CONF-870894—2; UCB-NE—4098). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011225.

From American Society of Civil Engineers engineering hydrology symposium; Williamsburg, VA, USA (3 Aug 1987).

This document shows analytic solutions to the problem of hydrogeologic transport of radionuclides released from finite areal

sources into a planar fracture. It illustrates the solutions through numerical and graphical displays of the spatial and temporal distribution of the radionuclides as a result of advection in the fracture, transverse dispersion and surface sorption, as well as diffusion into and sorption in the rock matrix. The numerical illustrations indicate that sufficient distances away from the sources equivalent single sources give acceptable approximations. 2 refs., 3 figs.

40543 **(NAGRA-NTB—84-01) Experiments on container materials for Swiss high-level waste disposal projects. Part 2.** Simpson, J.P. (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Dec 1984. 100p. Nagra, CH-5401 Baden, Switzerland.

The present concept for final disposal of high-level waste in Switzerland consists of a repository at a depth of 1000 to 1500 m in the crystalline bedrock of northern Switzerland. The waste will be placed in a container which is required to function as a high integrity barrier for at least 1000 years. This report is the second of a set of two dealing with the evaluation of potential materials for such containers. Four materials were identified for further evaluation in the first of these reports; they were cast steel, nodular cast iron, copper and Ti-Code 12. It was concluded that some testing was needed, in particular with respect to corrosion, in order to confirm these materials as candidate container materials. The experimental programme included: 1) corrosion tests on copper under gamma radiation; 2) immersion corrosion tests on the four candidate materials including welded specimens; 3) corrosion testing of the four materials in saturated bentonite; 4) constant strain rate testing of Ti-Code 12 and copper at 80 degrees C; 5) the behaviour of copper, Ti-Code 12 and Zircaloy-2 when immersed in liquid lead; 6) corrosion potential and galvanic current measurements on several material pairs. The standard test medium was natural mineral water from the Bad Saeckingen source. This water has a total dissolved solids content of approx. 3200 mg/l, about 1600 mg/l as chloride. The oxygen level was defined as 0.1 μg/g. In certain cases this medium was modified in order to test under more severe conditions. The results of the corrosion tests confirm in general the evaluation in the first part of the report. All of the materials are suitable for high-level waste containers: cast steel, nodular cast iron and copper as single layer containers, and Ti-Code 12 as an outer corrosion resistant layer. Copper could also be used under an outer steel layer, where it could arrest local penetration.

40544 **(NAGRA-NTB—84-05) Aluminium oxide containers for the final disposal of high-level radioactive wastes.** (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Mar 1984. 77p. (In German). Nagra, CH-5401 Baden, Switzerland.

The report presents a highly radioactive waste container concept based on the use of hot isostatically pressed aluminium oxide. The container is made of two cylindrical parts closed each at one end, which are sealed by means of a gold diffusion weld after introduction of the vitrified waste package. It is shown that the corrosion rate of the alumina material under conditions similar to those expected in Switzerland will most probably be less than 0.15 mm in 1000 years. The design consists of a cylinder about 2 m in length and 0.7 m in outer diameter, with hemispherical ends, ensuring that no tensional stress is present when the container is subjected to an external uniform pressure. The seal is positioned in the cylindrical part of the container, 150 mm away from the hemispherical end; in this way the stresses in the seal due to end effects and local bending can be made sufficiently small. A stress analysis shows that for such a design a wall thickness of 60 mm is sufficient to fulfill the requirements of the stress and stability criteria even with the use of a very high safety factor, for an external pressure of 300 bar, corresponding to a repository depth of 1200 m. For the protection of the personnel during the transport operations in the repository a metallic, temporary transport overpack is necessary; this overpack also protects the container against shocks.

40545 **(NAGRA-NTB—84-06) Exploratory borehole Kaisten. Working program.** (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Jan 1984. 97p. (In German). Nagra, CH-5401 Baden, Switzerland.

The next well on the Nagra drilling programme, Kaisten, lies at the southern border of the Rhine valley. An extensive geophysical borehole logging programme will serve to verify the results of the core analysis and complement the core data. Numerous borehole logs are to be registered with different types of tools. These allow one to determine various parameters essential for the full description of the rock sequences penetrated. A first category of logs enables the petrographical identification of the different rock types and indicates porous zones that are either water- or hydrocarbon-bearing. A second category provides data e.g. on the degree of pore and fracture fill, rock density and rock temperature, natural gamma radiation and rock-mechanical properties. Other logs measure strike and dip of the sedimentary layers and the position of rock fractures. A fourth category provides information on the diameter and the deviation of the borehole, the quality of casing cementations and the position of casing joints. In addition, well shooting surveys will supply exact values of seismic velocities for the various rock units; data that are needed for the depth correction of the reflection profiles from Nagra's regional seismic network. With numerous hydrological tests ranging from production tests of the Buntsandstein aquifer to labelled slug-tests in low-permeability crystalline sections, the hydraulic conditions of deep groundwater flow will be investigated. The recovered water samples will undergo full physical and geochemical analysis. Furthermore, their isotope content is to be measured in order to estimate the age of the various formation waters and their time of residence in the subsurface.

40546 **(NAGRA-NTB—84-07) Literature survey of possible microbiological processes in underground caverns used for the final storage of radioactive wastes.** Bachofen, R.; Luescher, D. (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Dec 1984. 86p. (In German). Nagra, CH-5401 Baden, Switzerland.

A nuclear waste repository is not expected to be free from microorganisms. The question arises whether growth and physiological activity of these organisms might present a risk for the safety of the waste disposal. The availability of water is an absolute prerequisite for the development of microorganisms. It can be present as condensed water inside the waste containers or due to water entering into the cavern. If this basic necessity is fulfilled, the activity of certain bacteria may become important. Microorganisms are capable of degrading organic material and may contribute to the corrosion of metals and concrete by excreting acids. Products of metabolism might transform insoluble substances, as certain heavy metals, into soluble forms. Finally gases might be formed and this could lead to the development of inflammable mixtures. It is, however, not possible to give a quantitative assessment of the consequences of microbial activities in a nuclear waste disposal because the existing data base is not sufficient.

40547 **(NAGRA-NTB—84-08) Crystalline materials for the solidification of high-level radioactive wastes.** Grauer, R. (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Feb 1984. 112p. (In German). Nagra, CH-5401 Baden, Switzerland.

Highly active wastes from reprocessed nuclear fuels must be incorporated into a solid chemically resistant inorganic matrix prior to final storage. One possible alternative to glassification is to imbed the complex oxide mixture in a cristalline ceramic. A discussion from the structural and chemical viewpoint is presented giving guidelines for the selection and development of such a product. The chemical and phase composition concerning the most important developments are described. SYNROC is the most highly developed solid ceramic that has been evaluated to date for power reactor wastes. However, its testing and development so far has been restricted to simulated inactive materials. One of the most important aspects of solid high activity wastes is their behaviour in water. SYNROC reacts more slowly than glasses with water at temperatures over 100 degrees C. Its low release of actinides under these conditions is remarkable. At temperatures under 100 degrees C the important nuclide Cs^{137} is released from SYNROC and from glasses at comparable rates. These assertions concerning chemical stability are however based on short term experiments, which have not considered the possibly complex interactions occuring during final storage. The information is therefore insufficient to describe the basic model required to predict long term behaviour under final storage

conditions. Finally the report makes recommendations for a further programme of work.

40548 **(NAGRA-NTB—84-09) Application-ready cement recipes for solidification of low and medium level radioactive wastes from nuclear power plants.** Laske, D.; Huebner, W.; Kuenzle, M.; Fischer, P. (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Sep 1984. 38p. (In German). Nagra, CH-5401 Baden, Switzerland.

The R+D program for solidification of low and medium level wastes from Swiss power plants is carried out at EIR (Swiss Federal Institute for Reactor Research) under contract to Nagra (National Cooperative for the Storage of Radioactive Waste). Up to now, 7 practicable recipes for these waste types have been developed for use. With these recipes the main quantities of all possible reactor radwastes arising from operating Swiss power plants can be solidified with cements. The solidified matrixes then produced fulfill the conditions required by the Swiss regulatory authorities. As a first barrier, they contribute to a safe final storage of these wastes in geological formations in Switzerland. For new waste types arising, for special wastes, and for the wastes from power stations not yet commissioned, the R+D work is going on. Future results will probably allow further improvement of the recipes and processes already developed.

40549 **(NAGRA-NTB—84-10) Monitoring of radioactive wastes: 1984 update.** Houriet, J.Ph. (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). May 1984. 73p. (In French). Nagra, CH-5401 Baden, Switzerland.

The general subject of monitoring radioactive wastes has been presented in the Nagra Technical Report NTB 82-02. This present report is an updating of NTB 82-02. The information in this supplement has been extracted from completely new sources. It will also serve as the basis for a proposed study, the objective of which will be to demonstrate the characterisation and control of radioactive wastes using monitoring techniques. Up to the present time waste monitoring techniques have concentrated on uranium and plutonium because of their importance and of the difficulty of their measurement. This continues to be the case in this report. The monitoring of radionuclides emitting high energy gammas will be expanded, particularly in regard to quantitative measurements. Finally, all radionuclides which can represent a hazard during final storage, whether alpha, beta or gamma emitting, will be studied (mentioned study) with respect to the possibility for direct and/or indirect analysis and measurement of radwaste.

40550 **(NAGRA-NTB—84-13) Geophysical investigation program for Northern Switzerland: pilot magnetotelluric exploration 81.** Fischer, G.; Schnegg, P.A.; Le Quang, B.V. (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Sep 1984. 40p. (In French). Nagra, CH-5401 Baden, Switzerland.

A pilot study has been undertaken to determine the contributions which might be expected from the magnetotelluric method in the search for and evaluation of sites suitable for the permanent disposal of radioactive nuclear wastes. Magnetotellurics usually yields structural information concerning the electrical conductivity but needs the help of other methods to fully resolve the structure. There are instances, however, where it is well suited to localize geological faults or fractures, e.g., when the crushed rock within the fault takes up water and becomes a much better conductor than the compact matrix. Unfortunately such favorable conditions were not found in the area of the present study as the hostrock was itself already a good conductor of electricity.

40551 **(NAGRA-NTB—84-18) Swelling pressure of highly compacted bentonites.** Bucher, F.; Spiegel, U. (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Dec 1984. 61p. (In German). Nagra, CH-5401 Baden, Switzerland.

Swelling pressure measurements carried out on highly compacted samples of commercially available bentonites (Na-bentonite MX-80 from Wyoming and Ca-bentonite Montigel from Bavaria) as well as of metabentonite from Kinnekulle (Sweden) and of illite from the Massif Central (France) are reported. The swelling pressure depends strongly on the final density of the sample (determined after completion of the swelling process) with values for the bentonites ranging from 5 MPa at a final dry density of 1.6 Mgm^{-3} to about 40 MPa at a final dry density of 2.0 Mgm^{-3}. In this density range the Ca-bentonite has a somewhat higher swelling pressure than the Na-bentonite; the temperature dependence and the influence of the water composition up to mineralisation levels of 3.5 g/l are small. When increasing the water pressure the difference in the measured total swelling pressure is, for final dry densities above 1.7 Mgm^{-3}, somewhat smaller than the increase in the applied water pressure. The metabentonite and the illite samples investigated exhibit a significant swelling potential that is further enhanced by subjecting them to ultrasonic treatment. The few measurements of the hydraulic conductivities gave values of about $5x10^{-14}$ m/s for the Na-bentonite and about 10^{-12} m/s for the illite investigated.

40552 **(NAGRA-NTB—84-19) Container materials for the disposal of high-level radioactive wastes: Corrosion chemistry aspects.** Grauer, R. (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Aug 1984. 114p. (In German). Nagra, CH-5401 Baden, Switzerland.

Prior to disposal in crystalline formations it is planned to enclose vitrified highly radioactive waste from nuclear power plants in metallic containers ensuring their isolation from the groundwater for at least 1000 years. Appropriate metals can be either thermodynamically stable in the repository environment (such as copper), passive materials with very low corrosion rates (titanium, nickel alloys), or metals such as cast iron or unalloyed cast steels which, although they corrode, can be used in sections thick enough to allow for this corrosion. The first part of the report presents the essentials of corrosion science in order to enable even a non-specialist to follow the considerations and arguments necessary to choose the material and design the container against corrosion. Following this, the principles of the long-term extrapolation of corrosion behaviour are discussed. The second part summarizes and comments upon the literature search carried out to identify published results relevant to corrosion in a repository environment. Results of archaeological studies are included wherever possible. Not only the general corrosion behaviour but also localized corrosion and stress corrosion cracking are considered, and the influence of hydrogen on the material behaviour is discussed. Taking the corrosion behaviour as criterion, the author suggests the use either of copper or of cast iron or steel as an appropriate container material. The report concludes with proposals for further studies.

40553 **(NAGRA-NTB—84-20) Geo-scientific basis for the investigation site Oberbauenstock. Volume 1.** Schneider, T.R.; Kappeler, S.W. (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Dec 1984. 250p. (In German). Nagra, CH-5401 Baden, Switzerland.

The geological and hydrogeological conditions prevailing in the region of the investigation site Oberbauen Stock have been chosen as model data-set, in the frame of project Gewaehr 1985, for a type B (low and intermediate level) waste repository. The report, in its capacity as a reference report for project Gewaehr presents all available, relevant site data applicable to modeling of the site. The sources of the data are presented. Geological studies and investigations, boreholes and geophysical investigations prior to the construction of the Seelisberg tunnel (as well as all underground facilities pertaining to the said tunnel) are described. In the section devoted to geology, the stratigraphy and the tectonics of the helvetic nappes in the area of the site are described. Further, the host rock, the neighbouring formations and the local tectonics are presented. In conclusion the geological boundary conditions of the area are summarized. The section devoted to hydrogeology deals with the observations and measurements carried out at the surface and in the underground facilities. As well, the present state of knowledge concerning the water chemistry is described. The section also includes a description of the regional hydrogeology. Concerning rock mechanics a summary and discussion of all available parameters and excavation classes is presented. A description of all the experiences acquired during construction follows as a second part. The section ends with a presentation of the observations and measurements of

the gas content of the host rock and other formations. A section concerning long-term behaviour concludes the report. Possible future changes of the geology and the climate are investigated. The consequences for the model site are discussed. It is concluded that a negative impact to a repository on the site is improbable on a timescale of 10^5 years.

40554 **(NAGRA-NTB—84-22) Geophysical investigation programme of Northern Switzerland: Gravimetric measurements 81/82.** Klingele, E.; Schwendener, H. (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Oct 1984. 70p. (In German). Nagra, CH-5401 Baden, Switzerland.

Within the frame of the geophysical investigations of the NAGRA in the northern part of Switzerland the Swiss Geophysical Commission has measured 4954 gravity stations. The gravity data were processed and presented as Bouguer-anomaly and residual anomaly maps. The densities used for the corrections were 2.40 and 2.67 g/cm^3. The residual field showed a negative anomaly along an axis passing through Weiach and Villigen. This anomaly can be interpreted quantitatively in terms of depth of the crystalline basement.

40555 **(NAGRA-NTB—84-23) Concept for a station for the encapsulation of vitrified highly radioactive waste into containers for final disposal.** (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Sep 1984. 33p. (In German). Nagra, CH-5401 Baden, Switzerland.

The report presents a concept and plans for a station for the encapsulation of vitrified highly radioactive waste into containers for final disposal. The process steps, the layout of the station, the main components of equipment and the sequence of operations under normal conditions are described. The station is designed for vitrified waste from reprocessing. The volume of the waste packages is 150 l, and each package contains the equivalent of 1.33 tonne HM of fuel. The radionuclide activity of the waste corresponds to spent fuel with a decay time of 40 years from discharge from the reactor. It is assumed that after transport under normal conditions the steel shell enclosing the waste is gastight and its surface is free of contamination. The containers for final disposal are made of cast steel and have the form of hollow cylinders with hemispherical ends; their overall length is 2 m and their overall diameter 0.94 m. The station is so designed that the whole procedure, from supply of the transport containers containing the waste to the delivery of the full final disposal containers, is carried out by remote control behind radiation screens in an area isolated from the environment. Containers that do not fulfill the quality control requirements can be improved or repaired in a special rework cell without interfering with the further normal operation of the plant.

40556 **(NAGRA-NTB—84-24) Permeability, porosity and retardation characteristics of granite samples from the Boettstein borehole; a laboratory study.** Carlsen, L.; Platz, D. (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Mar 1985. 24p. Nagra, CH-5401 Baden, Switzerland.

A liquid chromatography technique was utilized to explore permeability, porosity, and retardation laboratory characteristics of a series of granite samples from 489-670 m depth of the Boettstein borehole, as part of the Nagra deep drilling programme in Northern Switzerland. The samples comprised cores with old healed, mineral/clay-filled fractures and cores of fresh intact rock without filled fractures. These samples revealed no detectable water flow at pressure drops up to 90 bar, i.e., their hydraulic conductivities were smaller than $4x10^{-14}$ m sec^{-1}. After artificially fissuring and compressing the samples hydrostatically with pressures approximating the initial rock overburden, the fresh and reopened fissures exhibit values of 10^{-9}-10^{-10} and 10^{-11} m sec^{-1}, respectively, with flow porosities usually smaller than 0.5 %. These fissures displayed a strong tendency to rapid self-healing by contact with the relatively HCO_3^--rich Saeckingen water which was used in the experiments. These results suggest that groundwater transport through unfractured solid Boettstein granite is limited to aqueous phase diffusion in micropores. Retardation of the sorbing species TcO_4^-, Sr^{2+}, and Co^{2+} was established in an artificially induced fissure in a fresh granite sample. The values of 0.16, 0.24, and 0.04, respectively, must be interpreted with great caution, since the applied hydraulic gradient of 2800, and hence the resulting flow rate were unrealistically high.

40557 **(NAGRA-NTB—84-26) Scenarios of geological long-term safety: risk analysis for a final repository for high-level radioactive wastes in Northern Switzerland.** Diebold, P.; Mueller, W.H. (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Jan 1985. 122p. (In German). Nagra, CH-5401 Baden, Switzerland.

A synopsis is presented of the geological risk factors for a high level radioactive waste repository in Northern Switzerland. The study is based on results available so far of the ongoing regional geological and neotectonic investigations. Scenarios of possible future geological situations have been derived by combining data of observed and/or measured ongoing neotectonic processes with those of reconstructed trends of past geological history. These scenarios have been used to predict the impact of possible future geological developments and events on a repository for a time horizon of approx. one million years. Two regional scenarios provide the framework for the megatectonic development: In scenario A the alpine orogenic cycle is assumed to have come to an end, tectonic movements would gradually die out. In such a scenario the safety of a repository within the Basement at a depth of some 1200 m is not considered to be at risk. For scenario B the alpine orogeny is assumed to be actively continuing now and for the next 10 million years. Therefore, tectonic deformation in the Jura-mountains and the Black Forest would also continue. However, the results of the risk analysis indicate that plausible future geological developments within the timeframe of one million years would not adversely affect the safety of a repository.

40558 **(NAGRA-NTB—84-27) Stripa Project. Annual report 1983.** (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). May 1984. 43p. Nagra, CH-5401 Baden, Switzerland.

The Stripa Project is organized as an autonomous project of the Nuclear Energy Agency of the OECD. In the period from 1980-84 an international cooperative programme of investigations is being carried out in an underground rock laboratory in Sweden. The aim of the work is to improve our knowledge in the following areas: hydrogeological and geochemical measurement methods in boreholes; flow of groundwater and transport of radionuclides in fissured rock; geochemistry of groundwater at great depths; behaviour of backfill material in a real geological environment. Switzerland is represented in the Stripa Project by Nagra.

40559 **(NAGRA-NTB—84-31) Cast steel container for the final disposal of vitrified high-level radioactive wastes.** (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Apr 1985. 170p. (In German). Nagra, CH-5401 Baden, Switzerland.

The present concept of Nagra for the disposal of highly active, vitrified waste from reprocessing in the crystalline bedrock of Northern Switzerland includes containers as one of several safety barriers. Such containers are required to remain leaktight and withstand an external isostatic pressure of 300 bar (corresponding to the maximum swelling pressure of the compacted bentonite used as buffer material). The report describes a container made of cast steel GS 40 designed for the above requirements; the container consists of a thick-walled, self-supporting cylindrical shell with hemispherical ends, one of these being a lid that is welded onto the main body of the container. The external diameter is 940 mm and the total length 2000 mm. The wall thickness is 250 mm in the cylindrical body and 150 mm in the hemispherical ends. On the inside of the lower part of the container and of the lid extra radiation shields are provided. The total weight of the container filled with vitrified HLW is 8900 kg. The container is constructed so that, under the external pressure of 300 bar, tensile or shear stresses that might be detrimental from the point of view of corrosion are avoided or kept to very low levels. Particular attention was devoted to ensuring the absence of stresses at the weld by designing carefully the welding surfaces and the contact surface between lid and body of the con-

tainer; the weld's only purpose is to ensure leaktightness. The processes necessary for the manufacture and quality assurance are state-of-the-art. The required long-term corrosion resistance is obtained through the provision of a 50 mm corrosion allowance; this is conservative since the results of the corrosion programme of Nagra indicate that a maximum depth of penetration of less than 30 mm in 1000 years is to be expected.

40560 **(NAGRA-NTB—85-45) Exploratory application type B, NSG 15, 16 and 17: the hearing procedure.** Boutellier, C.; Gassner, R.; Kappeler, S. (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Jul 1985. 123p. (In German). Nagra, CH-5401 Baden, Switzerland.

The present report deals with one stage of geological investigations in a project for the repository for low- and intermediate-level radioctive wastes. Following an exhaustive selection procedure involving some hundred potential location territories, three were chosen for further detailed investigation. Application for licensing these explorations has been made to the Federal Ministry for Transport and Energy. Public objections can be made and at the time of the publication of this report no decision by Parliament had been taken.

40561 **(NUREG/CR—4919) Field testing of bentonite and cement borehole plugs in granite.** Kimbrell, A.F.; Avery, T.S.; Daemen, J.J.K. (Arizona Univ., Tucson (USA). Dept. of Mining and Geological Engineering; Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering Safety). Jul 1987. 340p. NTIS, PC A15/MF A01 - GPO. File Number TI87900920.

This report describes in-situ flow tests on bentonite and cement borehole plugs installed in granite, as well as laboratory back-up experiments on similar plugs. Prior to sealing, the hydraulic conductivity of the boreholes is tested. These measurements, together with core logs and borehole videologs, permit the selection of suitable seal test intervals. Commercial expansive cement and standard waterwell sealing bentonite products and emplacement procedures are used for borehole sealing. Transient (short-term) and steady-state (long-term) testing determines the sealing performance of the plugs under various stress conditions. Both laboratory and field experiments confirm the great difficulty of obtaining even moderately accurate performance values for bentonite plugs as installed here, due to the simultaneous saturation, swelling, and consolidation effects. Nevertheless, conventional installation of readily available seals can provide adequate borehole seals (i.e., seals with a hydraulic conductivity of about the same order of magnitude as that of intact granite). Bentonite plugs of this type are heterogeneous and weak. Improved testing procedures and analyses are needed if actual conductivity values are to be obtained in a reasonable testing time (e.g., months). Laboratory investigations on failure mechanisms in cementitious and bentonitic plugs, not covered in this research study, are needed to identify and prevent plug failure.

40562 **(PB—87-188421/XAB) Seismic analysis of rack structures for fuel-cycle facilities.** Mochio, T.; Morooka, A.; Ito, T. (Mitsubishi Heavy Industries Ltd., Tokyo (Japan)). 1987. 8p. (In Japanese). NTIS, PC PC E04/MF E01.

Included in Mitsubishi Juko Giho, Vol. 24, No. 1, 1-8(1987).

A concept of remote maintenance using in a large remote cell and rack system structure, now under development at the high active liquid waste vitrification facility of PNC and West Germany reprocessing plant WA-350, has been adopted to reduce the radiation exposure and increase the operating efficiency. The operation of a highly efficient remote maintenance system sometimes requires the rack structures to be fairly flexible, because of the large number of loose connections and/or gapped supports and the low number of rack frames. This means that there is a possibility of severe damage occurring due to large amplitude responses during a strong earthquake. Therefore, it is very important to estimate the earthquake-resistance capacity of rack structures, including process equipment, to earthquake excitation. The paper represents an outline of a new computer code FRACK to analyze the nonlinear seismic response of a rack structure developed as a first stage in the rack system seismic research program.

40563 **(PTB-SE—15) Requirements to be met by waste forms in order to account for the thermal load affecting the host rock in the Konrad shaft plant. As of September 1, 1986.** Piefke, F. (Physikalisch-Technische Bundesanstalt, Braunschweig (Germany, F.R.). Abt. Sicherstellung und Endlagerung Radioaktiver Abfaelle). Sep 1986. 21p. (In German). NTIS, PC E07; Available from NTIS as TIB/B87-09399.

The activity values are listed that result from the thermal load affecting the host rock. The values given are not activity limits in the strict sense, because within the framework of 'diluted' storage it is quite possible to store waste forms whose activities exceed the limits set. What must be restricted, though, is the heat output per unit length of the storage facility.

40564 **(SAND—85-7209) Backfill material specifications and requirements for the WIPP simulated DHLW and TRU waste technology experiments.** Pfeifle, T.W. (RE/SPEC, Inc., Rapid City, SD (USA)). Jul 1987. Contract AC04-76DP00789. 90p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87013120.

The widespread use of different backfill materials in the Waste Isolation Pilot Plant (WIPP) simulated Defense High Level Wastes (DHLW) and Transuranic (TRU) waste technology experiments presents the need for a complete description and in situ test of backfill materials. The description includes: backfill placement locations, material specifications, material requirements (i.e., volume and weight), and materials handling. This report describes and presents the physical layout of the experiments showing locations for backfill material placement; describes each backfill material; presents calculations of the volume/weight requirements for each material; and gives conceptual designs of equipment for material handling, transport, and emplacement. The six backfill materials described include: crushed salt; 70/30 (percent by weight) crushed salt/bentonite; 70/30 (percent by weight) bentonite/silica sand (low density); 70/30 bentonite/silica sand (high density); silica sand; and air (i.e., no backfill). 19 refs., 20 figs., 4 tabs.

40565 **(UCRL—94721) Leaching of actinide-doped nuclear waste glass in a tuff-dominated system.** Bazan, F.; Rego, J.; Aines, R.D. (Lawrence Livermore National Lab., CA (USA)). Jan 1987. Contract W-7405-ENG-48. 14p. (CONF-861207—111). NTIS, PC A02. File Number DE87012244.

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

A laboratory leaching test has been performed as part of a project to evaluate the suitability of tuff rocks at Yucca Mountain, Nevada, as a site for a high-level nuclear waste repository. Glass samples were placed in water inside tuff vessels, and then the tuff vessels were placed in water inside Teflon containers. Glass-component leach rates and migration through the tuff were measured for samples of the ATM-8 actinide glass, which is a PNL 76-68 based glass doped with low levels of ^{99}Tc, ^{237}Np, ^{238}U, and ^{239}Pu to simulate wastes. Disc samples of this glass were leached at 90°C for 30, 90, and 183 days inside tuff vessels using a natural groundwater (J-13 well-water) as the leachant. At the end of each leaching interval, the J-13 water present inside and outside the rock vessel was analyzed for glass components in solutions. Boron, molybdenum, and technetium appear to migrate through the rock at rates that depend on the porosity of each vessel and the time. The actinide elements were found only in the inner leachate. Normalized elemental mass loss values for boron, molybdenum, and technetium were calculated using concentrations of the inner and outer leachates and assuming a negligible retention on the rock. The maximum normalized release was 2.3 g/m^2 for technetium. Boron, molybdenum, technetium, and neptunium were released linearly with respect to each other, with boron and molybdenum released at about 85% of the technetium rate, and neptunium at 5 to 10% of the technetium rate. Plutonium was found at low levels in the inner leachate but was strongly sorbed on the steel and Teflon supports. Neptunium was sorbed to a lesser extent. 8 refs., 6 figs., 6 tabs.

40566 (VROM-DSB—85-6) Choice of locations for disposal of dangerous (radioactive) waste. Managerial and psychological aspects. Hisschemoller, M.; Midden, C.J.H.; Stallen, P.J. (Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer, The Hague (Netherlands). Directie Stralenbescherming). Nov 1985. 128p. (In Dutch). (VROM—851009/12-85). NTIS (US Sales Only), PC A07/MF A01. File Number DE87702860.

In this report a managerial and psychological analysis, based on literature study and case analysis, is presented of various policy strategies which are or can be followed by governments in decisions about disposal of dangerous waste. Special attention is given to radioactive waste. 98 references, 4 figures, 2 tables.

40567 Preliminary bounds on the expected postclosure performance of the Yucca Mountain Repository Site, southern Nevada. Sinnock, S.; Lin, Y.T.; Brannen, J.P. (Geoscience Analysis Division 6315, Sandia National Laboratories, Albuquerque, New Mexico). *Journal of Geophysical Research;* **92**: No. B8, 7820-7842(10 Jul 1987).

On the basis of current data and understanding of site characteristics at Yucca Mountain, the likely performance range of a mined repository for spent nuclear fuel can be calculated. Low flux through the unsaturated zone results in groundwater travel times to the water table that probably exceed 10,000 years and may exceed 100,000 years, far longer than required by the Nuclear Regulatory Commission (NRC). The low flux will also limit releases of waste from the waste packages, probably to annual amounts less than one millionth of the mass of the waste inventory remaining 1000 years after repository closure; the corresponding releases of curies would be well within the allowable releases set by the NRC. Geochemical retardation by sorption and diffusion will slow radionuclide movement relative to groundwater flow by factors of hundreds to thousands for many waste species. In combination, these site conditions provide a high degree of confidence that no releases to the accessible environment will occur during the first 10,000 years after repository closure, the time period for which the Environmental Protection Agency (EPA) has set release limits. Carbon 14, technetium 99, iodine 129, and various nuclides of uranium sorb poorly on the tuffs along the flow path and, together with uranium daughter products, will be the first radionuclides to arrive at the water table.

40568 Evaluation of alterant geophysical tomography in welded tuff. Ramirez, A.L.; Daily, W.D. (Lawrence Livermore National Laboratory, Livermore, California). *Journal of Geophysical Research;* **92**: No. B8, 7843-7853(10 Jul 1987).

Electromagnetic measurements have been performed at 300 MHz to evaluate the applicability of alterant geophysical tomography to delineate in situ flow paths in a welded tuff rock mass. The evaluation has involved a field experiment, which was supplemented by a test bed experiment and a computer simulation study. The field measurements were made before, during, and after a water-based dye tracer flowed through the rock mass. Alterant geophysical tomographs are compared with independent evidence: maps of fractures intersected by the measurement boreholes and dyed rock samples. Anomalies present in the tomograph match fractures mapped with a borescope. The locations of tracer-stained fractures coincide with the locations of most image anomalies. The core data show that some of the image anomalies represent flow through single fractures. Other geophysical anomalies required further evaluation because they existed where tracer-stained fractures were not observed. The field images were also evaluated using evidence from a computer simulation study and from a test bed experiment where the technique was evaluated under controlled conditions. The results from these supplementary tests suggest that the field test image anomalies without corresponding dyed fractures are unlikely to be artifacts and thus probably represent flow paths of the tracer through the rock. copyright American Geophysical Union 1987

40569 Hydrological properties of Topopah Spring tuff: Laboratory measurements. Daily, W.; Lin, W.; Buscheck, T. (Lawrence Livermore National Laboratory, Livermore, California). *Journal of Geophysical Research;* **92**: No. B8, 7854-7864(10 Jul 1987).

The purpose of this work is to study the transport of water (both the liquid and vapor phases) in tuff from the Topopah Spring welded unit under conditions expected in the near-field environment of a high-level nuclear waste container. A naturally fractured sample of Topopah Spring tuff (approximately 8 cm in diameter and 10 cm long) from Yucca Mountain at the Nevada Test Site, Nevada, was studied using, as a pore fluid, natural groundwater recovered from a well in which the principal producing horizon is the Topopah Spring Member. Confining pressure, sample temperature, and pore pressure were held at values that simulate expected in situ near-field conditions shortly after emplacement of the container. Results of this work are comparable with results from previous similar experiments on 2.54-cm-diameter samples of Topopah Spring tuff. During the more than 6-month experiment duration, water permeability decreased about 3 orders of magnitude. The most rapid measured permeability change (between about 600 and 100 μdarcy) occurred when the sample temperature was increased from room temperature to 89° C.

40570 DOE progress in assessing the long term performance of waste package materials. Berusch, A.; Gause, E. (Dept. of Energy, Washington, DC). pp 13-28 of Scientific basis for Nuclear Waste Management X. Bates, J.K.; Seefeldt, W.B. (eds.). Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—Pt.1).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

Under the Nuclear Waste Policy Act of 1982 (NWPA)[1], the US Dept. of Energy (DOE) is conducting activities to select and characterize candidate sites suitable for the construction and operation of a geologic repository for the disposal of high-level nuclear wastes. DOE is funding three first repository projects: Basalt Waste Isolation Project, BWIP; Nevada Nuclear Waste Isolation Project, NNWSI; and Salt Repository Project Office, SRPO. It is essential in the licensing process that DOE demonstrate to the NRC that the long-term performance of the materials and design will be in compliance with the requirements of 10 CFR 60.113 on substantially complete containment within the waste packages for 300 to 1000 years and a controlled release rate from the engineered barrier system (EBS) for 10,000 years of 1 part in 10^5 per year for radionuclides present in defined quantities 100 years after permanent closure. Obviously, the time spans involved make it impractical to base the assessment of the long term performance of waste package materials on real time, prototypical testing. The assessment of performance will be implemented by the use of models that are supported by real time field and laboratory tests, monitoring, and natural analog studies. Each of the repository projects is developing a plan for demonstrating long-term waste package material performance depending on the particular materials and the package-perturbed, time-dependent environment under which the materials must function. An overview of progress in each of these activities for each of the projects is provided in the following.

40571 Development, application and validation of models for waste package long-term performance; current trends. Werme, L.O.; Grambow, B. (Swedish Nuclear Fuel and Waste Management Co., Stockholm). pp 29-43 of Scientific basis for Nuclear Waste Management X. Bates, J.K.; Seefeldt, W.B. (eds.). Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—Pt.1).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

Current trends in modelling waste package performance are reviewed mainly from the perspective of the Swedish SKB studies. Examples are given, which illustrate the approaches for modelling different waste forms, i.e. HLW glass and spent nuclear fuel, and candidate canister materials, such as copper and steel. The relative importance of thermodynamics, reaction kinetics and near-field transport are discussed. 32 references, 7 figures, 1 table.

40572 Global database strategy for public engineering decision making. Fong, J.T. (National Bureau of Standards, Gaithersburg, MD). pp 45 of Scientific basis for Nuclear Waste Management X. Bates, J.K.; Seefeldt, W.B. (eds.). Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—Pt.1).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

A historical review of how engineers contributed to the solution of societal (public) and individual (private) problems is presented, with emphasis on the last thirty years when computers began to alter drastically the practice of engineering. The concept of a 3-prong representation of the engineering decision making process, i.e., database, analysis, and judgment, is introduced. The importance of generating a suitable body of experimental and actual performance data and of coupling the database with a state-of-the-art analysis and extrapolation methodology for public engineering is illustrated in three case studies involving (a) the nuclear reactor safety study of 1975, (b) the Alaska pipeline weld defect assessment study of 1976, and (c) the Welding Research Council-Pressure Vessel Research Committee (PVRC) Round Robin Flaw Detection Program (1966-86) for thick-section steel welds. For most of the public engineering projects involving long-term prediction of performance from short-term test data, the time-honored approach of supplementing experimental or service data with engineering judgment is frequently open to a public challenge. To remedy the situation, a new approach of using both the personal computers (PC) and the mainframes to (a) accelerate the peer review of existing data, (b) design a strategy for acquiring new data, and (c) facilitate a regional or global exchange of field data with standardized format, is outlined. Application of the above approach to strengthen the judgment component of public engineering projects such as the management of high-level nuclear wastes is discussed through an example on the fatigue life prediction of stainless steel 304 piping and components.

40573 **Structured program of research into the chemical aspects of radioactive waste disposal.** Read, D.; Krol, A.A.; Thompson, B.G.J. (Univ. of Wales Institute of Science and Technology, Cardiff). pp 343-354 of Scientific basis for Nuclear Waste Management X. Bates, J.K.; Seefeldt, W.B. (eds.). Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—Pt.1).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

The UK Department of the Environment (DOE) is developing an independent capability to assess proposals made by the nuclear industry for the underground disposal of low and intermediate level radioactive waste. Modelling chemical processes forms an integral part of the underlying DOE research program which includes the development of probabilistic risk assessment codes, more detailed deterministic models and supporting field and laboratory studies, in a coordinated, hierarchical approach. This paper summarizes the results of a survey on the current status of this and related research, with emphasis on the assessment of a safety case for shallow land disposal of low level waste in about two years time. Shortcomings in existing work are identified, and a structured program for future research described. 30 references, 4 figures, 1 table.

40574 **Attenuation of Pu, Am, Cs and Sr mobility in concrete.** Jakubick, A.T.; Gillham, R.W.; Kahl, I.; Robin, M. (Ontario Hydro, Toronto). pp 355-368 of Scientific basis for Nuclear Waste Management X. Bates, J.K.; Seefeldt, W.B. (eds.). Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—Pt.1).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

Sorption experiments with ^{85}Sr, ^{137}Cs, ^{239}Pu and ^{241}Am on four types of concrete (normal density, normal density with fly ash, high density and high density with silica fume) were carried out in a predominantly $CaCl_2$ groundwater, in a predominantly NaCl groundwater and in nitrate solutions. Subsequently, autoradiography was used to identify the sorption pattern on the concrete surfaces. In order to distinguish the effects of chemical sorption from that of variable surface area, the effective surface area was used to derive reactive-surface-related distribution coefficients instead of the geometric-surface-related distribution coefficients. 9 references, 5 figures, 7 tables.

40575 **Leaching studies of cement-glass package containing sodium borate.** Okamoto, M.; Chino, K.; Baba, T.; Izumida, T.; Kawamura, F.; Kikuchi, M. (Kansai Electric Power Co., Osaka, Japan). pp 393-398 of Scientific basis for Nuclear Waste Management X. Bates, J.K.; Seefeldt, W.B. (eds.). Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—Pt.1).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

A new solidification technique using cement-glass, which is a mixture of sodium silicate, cement, additives, and initiator of the solidification reaction, was developed for sodium borate liquid waste generated from pressurized water reactor (PWR) plants. The cement-glass could solidify eight times as much sodium borate as cement could, because the solidifying reaction of the cement-glass is not hindered by borate ions. The reaction mechanism of sodium silicate and phosphoric silicate (initiator), the main components of cement-glass, was studied through X-ray diffraction and compressive strength measurements. It was found that three-dimensionally bonded silicon dioxide was produced by polymerization of the two silicates. The leaching ratio of cesium from the cement-glass package was one-tenth that of the cement one. This low value was attributed to a high cesium adsorption ability of the cement-glass and it could be theoretically predicted accordingly. 8 references, 6 figures.

40576 **Biodegradation testing of bitumen.** Barletta, R.E.; Bowerman, B.S.; Davis, R.E.; Shea, C.E. (Brookhaven National Lab., Upton, NY). pp 399-405 of Scientific basis for Nuclear Waste Management X. Bates, J.K.; Seefeldt, W.B. (eds.). Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—Pt.1).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

An estimate of the rate of biodegradation of bituminous material is necessary to predict the long-term stability of low- and intermediate-level waste solidified using bitumen. Data from a series of scoping experiments have been analyzed to determine the rate of degradation of blown bitumen samples under a variety of conditions. Among the variables investigated were the effect of soil type, moisture, sample surface area and microbial strain. The rate of degradation was measured by monitoring metabolic CO_2 release. Using this data it was found that, for degradation in soil, a mean rate of 5.5×10^{-4} cm/yr represented all data to within a factor of about two. This mean rate is nearly that for distilled bitumen samples measured by other workers. 12 references, 3 figures, 2 tables.

40577 **Multicomponent systems tests on used fuel and fuel recycle waste glass at 200°C.** Heimann, R.B. (Atomic Energy of Canada Ltd., Pinawa, Manitoba). pp 409-420 of Scientific basis for Nuclear Waste Management X. Bates, J.K.; Seefeldt, W.B. (eds.). Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—Pt.1).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

Experiments were performed at 200°C and 8.5 MPa on used fuel and a borosilicate waste glass in contact with clay, container metals, groundwater and granite selected as reference materials in the Canadian Nuclear Fuel Waste Management Program. The experimental design considered five parameters that determine a fractional factorial design 2/sup 5-1/. The parameters varied were: waste form (used fuel or Moly 99 W glass), cation exchange capacity of the clay (calcium bentonite, 1360 meq/kg or illite, 160 meq/kg), ionic strength of the groundwater (Standard Canadian Shield Saline Solution, SCSSS, 1.4 mol/L or granitic groundwater, GGW, 1×10^{-3} mol/L), surface area to volume ratio (SA/V) (120 or 12 m^{-1}), and container material (Inconel 625 or Ticode 12). The results show that (i) maximum release of ^{137}Cs from used fuel and waste glass occurs in the presence of illite and GGW, (ii) maximum releases of ^{90}Sr and the actinides from used fuel occur in the presence of bentonite and SCSSS, and (iii) maximum release of ^{90}Sr from the waste glass occurs in the presence of illite and GGW. 13 references, 5 figures, 4 tables.

40578 Development and evaluation of a tracer-injection hydrothermal technique for studies of waste package interactions. Jones, T.E.; Coles, D.G.; Britton, R.C.; Burnell, J.R. (Pacific Northwest Lab., Richland, WA). pp 421-432 of Scientific basis for Nuclear Waste Management X. Bates, J.K.; Seefeldt, W.B. (eds.). Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—Pt.1). Contract AC06-76RL01830.

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

A tracer-injection system has been developed for use in characterizing reactions of waste package materials under hydrothermal conditions. High-pressure liquid chromatographic instrumentation has been coupled with Dickson-type rocking autoclaves to allow injection of selected components into the hydrothermal fluid while maintaining run temperature and pressure. Hydrothermal experiments conducted using this system included the interactions of depleted uranium oxide and Zircaloy-4 metal alloy discs with trace levels of ^{99}Tc and non-radioactive Cs and I in a simulated groundwater matrix. After waste-package components and simulated waste forms were pre-conditioned in the autoclave systems (usually 4 to 6 weeks), known quantities of tracer-doped fluids were injected into the autoclaves' gold reaction bag at run conditions. Time-sequenced sampling of the hydrothermal fluid provided kinetic data on the reactions of tracers with waste package materials. The injection system facilitates the design of experiments that will better define steady-state fluid compositions in hydrothermal reactions. The injection system will also allow for the formation of tracer-bearing solid phases in detectable quantities. 10 references, 3 figures, 3 tables.

40579 Integrated testing of the SRL-165 glass waste form. Phinney, D.L.; Ryerson, F.J.; Oversby, V.M.; Lanford, W.A.; Aines, R.D.; Bates, J.K. (Lawrence Livermore National Lab., CA). pp 433-446 of Scientific basis for Nuclear Waste Management X. Bates, J.K.; Seefeldt, W.B. (eds.). Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—Pt.1). Contract W-7405-ENG-48.

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

Integrated testing of the important components of a glass waste form waste package has been performed in order to gain a better understanding of the processes of radionuclide release and transport in the near field environment. Based upon an interpretation of the depth of penetration of hydrogen in reacted SRL-165 glass they have modeled the radionuclide release from the glass as a combined process of (1) the diffusive exchange of alkalis and boron in the glass for hydrogen species in the solution ($D = 10^{-16}$ cm^2/s) and (2) surface dissolution. Surface dissolution controls the release of components not exchanged by diffusion and takes place at a rate of 1.5-3.0 μm/yr. Subsequent to release the radionuclides may remain in the leach solution, diffuse into the tuff, or precipitate as secondary phases. Precipitation is particularly important for plutonium and americium. Diffusive transport of radionuclides through the tuff takes place at an extremely slow rate, $D = 10^{-16}$ cm^2/s. As such, the mass of radionuclides incorporated in the tuff by diffusion during the tests is inconsequential relative to that in the leach solution (with the exception of plutonium) and can be ignored in mass balance calculations. Mass balance calculations based upon the release of radionuclides by surface dissolution of the glass waste form are in good agreement with observed solution chemistry when allowances are made for a pulse of dissolution early in the tests. This pulse may be due to either the rapid dissolution of high-energy surface features early in the integrated tests, or an initially high surface dissolution rate that decreases with time as silica saturation is approached [1], or a combination of the two. 8 references, 7 figures, 2 tables.

40580 Leaching of actinide-doped nuclear waste glass in a tuff-dominated system. Bazan, F.; Rego, J.; Aines, R.D. (Lawrence Livermore National Lab., CA). pp 447-458 of Scientific basis for Nuclear Waste Management X. Bates, J.K.; Seefeldt, W.B. (eds.). Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—Pt.1).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

A laboratory leaching test has been performed as part of a project to evaluate the suitability of tuff rocks at Yucca Mountain, Nevada, as a site for a high-level nuclear waste repository. Glass samples were placed in water inside tuff vessels, and then the tuff vessels were placed in water inside Teflon containers. Glass-component leach rates and migration through the tuff were measured for samples of the ATM-8 actinide glass, which is a PNL 76-68 based glass doped with low levels of ^{99}Tc, ^{237}Np, ^{238}U, and ^{239}Pu to simulate wastes. Disc samples of this glass were leached at 90°C for 30, 90, and 183 days inside tuff vessels using a natural groundwater (J-13 well-water) as the leachant. Some samples were held by 304L stainless steel supports to evaluate the effect of this metal on the release rate of glass constituents. At the end of each leaching interval, the J-13 water present inside and outside the rock vessel was analyzed for glass components in solution. On the basis of these analyses, boron, molybdenum, and technetium appear to migrate through the rock at rates that depend on the porosity of each vessel and the time of reaction. The actinide elements (uranium, neptunium, and plutonium) were found only in the inner leachate. 8 references, 6 figures, 6 tables.

40581 Borosilicate glass corrosion in the presence of steel corrosion products. Bart, G.; Zwicky, H.U.; Aerne, E.T.; Graber, T.; Z'Berg, D.; Tokiwai, M. (Swiss Federal Institute for Reactor Research, Wuerenlingen). pp 459-470 of Scientific basis for Nuclear Waste Management X. Bates, J.K.; Seefeldt, W.B. (eds.). Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—Pt.1).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

Since 1982, the corrosion behavior of radioactive high level waste glass and of inactive glasses of the same composition has been studied in the framework of a Japanese-Swedish-Swiss (JSS) project. In addition to granite and backfilling material, the influence of steel corrosion products on glass corrosion has been investigated in experiments of up to one year at 90°C with a sample surface area to leachant volume ratio of 10 m^{-1}. Leachant and steel corrosion products were separated from each other by filtration and analyzed by atomic absorption spectroscopy and γ-spectroscopy. The glass corrosion layers were characterized by optical and scanning electron microscopy and by secondary ion mass spectrometry. It could be shown, that glass corrosion is enhanced by steel corrosion products. The quantity of corroded glass seems to be dependent on the surface area and not on the total amount of steel corrosion products in the system, suggesting a mechanism controlled by silica sorption on the steel corrosion product. If lead oxide is added to the system, glass corrosion is almost totally suppressed. 9 references, 11 figures, 4 tables.

40582 Modeling of the effect of iron corrosion products on nuclear waste glass performance. Grambow, B.; Zwicky, H.U.; Bart, G.; Bjoerner, I.K.; Werme, L.O. (Hahn-Meitner-Institut Berlin, West Germany). pp 471-481 of Scientific basis for Nuclear Waste Management X. Bates, J.K.; Seefeldt, W.B. (eds.). Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—Pt.1).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

Experiments [1], performed in the frame of the JSS-project (joint Japanese [CRIEPI], Swiss [NAGRA], Swedish [SKB] project), demonstrated that the effect of iron corrosion products on the long-term stability of HLW-glass depends on the effective surface area of the corrosion products. The experimental results were described quantitatively by thermodynamic and kinetic modeling with the computer codes GLASSOL and PHREEQE. The model interprets the effect in terms of surface sorption of a monolayer of silica molecules from solution. Silica saturation occurs in solution only, when all surface sites are occupied. The effect of bentonite is also considered. The agreement between calculations and experiment is about as good as in the case of modeling the glass-water reaction only. 11 references, 6 figures, 3 tables.

40583 **Standardized test methods for use in waste compliance testing in the Department of Energy's waste acceptance process.** Mellinger, G.B. (Pacific Northwest Lab., Richland, WA). pp 483-490 of Scientific basis for Nuclear Waste Management X. Bates, J.K.; Seefeldt, W.B. (eds.). Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—Pt.1).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

Producers of high-level waste forms will be required to demonstrate compliance with a number of acceptance specifications prior to disposal of their waste forms at a geologic repository. The Waste Acceptance Process was developed by the US Dept. of Energy (DOE) in 1985 to outline the documentation and activities required to ensure that waste forms used for the immobilization of high-level wastes from the reprocessing of spent nuclear fuel will be acceptable at any of the potential repositories. As part of this process, Waste Acceptance Preliminary Specifications (WAPS) have been developed for the borosilicate glass waste forms to be produced by the Defense Waste Processing Facility (DWPF) and the West Valley Demonstration Project. The West Valley WPAS [1] and the DWPF are essentially identical. These WAPS specify requirements that these waste forms must meet and documentation that must be supplied to the repository to which the waste will be sent. A number of WAPS requirements, such as those dealing with canister labeling and free-liquid within the canister, can probably be met through the use of administrative controls or literature data. For other requirements, testing will be needed. The purpose of this paper is to propose a set of tests for use in demonstrating compliance with the existing WAPS (both of which deal with glass waste forms). Some of these tests have been standardized. Others are undergoing standardization or are under development and may ultimately require standardization. The final decision about which tests will be appropriate for waste compliance testing will be made by the repository projects and the DOE Office of Civilian Radioactive Waste Management.

40584 **Waste glass leaching: chemistry and kinetics.** Bunker, B.C. (Sandia National Labs., Albuquerque, NM). pp 493-507 of Scientific basis for Nuclear Waste Management X. Bates, J.K.; Seefeldt, W.B. (eds.). Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—Pt.1). Contract AC04-76DP00789.

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

Nuclear waste glass leaching has been studied extensively during the past ten years. Although much has been learned concerning the kinetics and mechanisms of glass dissolution, it does not appear that accurate predictions can yet be made concerning the release kinetics for specific elements from a given glass as a function of environmental conditions. In order to reliably predict elemental release rates, one needs to know: (1) how a given element is incorporated into the glass structure, (2) how specific sites in the glass react with water, (3) how the composition and reactivity of the leachate influence glass reactivity, (4) how the structure and reactivity of the glass changes in surface alteration layers, and (5) how glass dissolution modifies the chemistry of the leachate. At their current level of understanding, they are only able to make qualitative predictions concerning each of the above factors which allow us to make order of magnitude or upper limit predictions for radionuclide release rates. 27 references, 10 figures.

40585 **Large scale leach testing of DWPF canister sections.** Bickford, D.F.; Pellarin, D.J. (E.I. du Pont de Nemours and Co., Aiken, SC). pp 509-518 of Scientific basis for Nuclear Waste Management X. Bates, J.K.; Seefeldt, W.B. (eds.). Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—Pt.1). Contract AC09-76SR00001.

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

A Large-Scale Leach Test Facility (LSLTF) has been constructed at the US Department of Energy's Savannah River Laboratory (SRL) to perform static leach tests on 24-inch (610 mm)-diameter canister sections cut from simulated (nonradioactive) waste forms cast under reference conditions. The equipment and test procedures are designed to closely correspond to MCC-1 leach test criteria. Less than a factor of 3 increase in leachability results from combined scale-up, glass-cracking, leached surface area estimation, and surface roughness effects. This factor is dominated by surface roughness of saw cut surfaces. The factor is negligible when compared to the 200,000/l ratio of glass sample masses. The MCC-1, and other small-scale leach tests have been valuable in determining the relative merits of alternative waste form compositions. However, the actual waste glass to be stored in repositories is subject to fracture, devitrification, and container/glass interactions, which are difficult to simulate on a laboratory scale. Large-scale leach tests integrate these and other possible waste form characteristics that are not represented in typical small samples. The facility, equipment, test method and results of one year leach testing are discussed. These results substantiate the applicability of small scale test data which precede this work, and the use of small scale tests to simulate leaching of the Defense Waste Processing Facility's borosilicate glass product. Exceptionally good sampling statistics make the large scale data particularly well suited for verification of models of leachability rates. 2 references, 6 figures, 2 tables.

40586 **Effects of aqueous phase composition on the leach behavior of nuclear waste glasses.** Feng, X.; Barkatt, A. (Catholic Univ. of America, Washington, DC). pp 519-531 of Scientific basis for Nuclear Waste Management X. Bates, J.K.; Seefeldt, W.B. (eds.). Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—Pt.1).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

A systematic matrix of leach tests on a West Valley waste glass composition is described. These tests are intended to provide quantitative systematic information on leachant composition effects, and accordingly elucidate the controlling processes in high-solute media, e.g. silicate ground water, brine, etc. In order to separate the effects of the nature and concentration of solutes from pH effects, leach tests were first carried out on the glass in de-ionized water under highly interactive conditions (high surface to volume ratio) in a configuration which prevented lowering the pH due to the intrusion of CO_2. After determination of the resulting pH, the leach behavior of the glass was characterized in a series of high-dilution tests in various leachants buffered at this pH value in order to quantify the effects of leachant composition and concentrations on the leaching process. The high-dilution conditions were used at this stage to ensure that the leachant composition would not be significantly affected by accumulation of leached glass components. It was concluded that increased ionic strength appears to depress the leach rates in near-neutral media but enhances the leach rates under moderately basic conditions. 10 references, 4 figures, 4 tables.

40587 **Transport and reaction kinetics at the glass:solution interface region: results of repository-oriented leaching experiments.** Abrajano, T.A. Jr.; Bates, J.K. pp 533-546 of Scientific basis for Nuclear Waste Management X. Bates, J.K.; Seefeldt, W.B. (eds.). Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—Pt.1).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

Repository-oriented leaching experiments involving Savannah River Laboratory (SRL) 165 type glass under a γ-radiation field ($1 \pm 0.2 \times 10^4$ R/h) have been performed by the Nevada Nuclear Waste Storage Investigations (NNWSI) project. In this communication, they discuss glass surface analyses obtained by SEM, nuclear resonance profiling, and SIMS together with leachate solution data in relation to a mechanism that couples diffusion, hydrolysis (etching and gelation), and precipitation to qualitatively describe the release of different glass components to the leachant solutions. The release of mobile (e.g., Li) and partly mobile (e.g., B) species is controlled primarily by interdiffusion with water species across the interdiffusion zone. Glass components that are immobile in the interdiffusion zone are released to the solution by etching. For prediction of long-term steady-state concentrations of glass components with low solubility, the relative rates of release from the glass and secondary mineral precipitation must be taken into account. 20 references, 5 figures, 1 table.

40588 **Hydrogen speciation in hydrated layers on nuclear waste glass.** Aines, R.D.; Weed, H.C.; Bates, J.K. (Lawrence Livermore National Lab., CA). pp 547-558 of Scientific basis for Nuclear Waste Management X. Bates, J.K.; Seefeldt, W.B. (eds.). Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—Pt.1). Contract W-7405-ENG-48.

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

The hydration of an outer layer on nuclear waste glasses in known to occur during leaching, but the actual speciation of hydrogen (as water or hydroxyl groups) in these layers has not been determined. As part of the Nevada Nuclear Waste Storage Investigations Project, we have used infrared spectroscopy to determine hydrogen speciations in three nuclear waste glass compositions (SRL-131 & 165, and PNL 76-68), which were leached at 90°C (all glasses) or hydrated in a vapor-saturated atmosphere at 202°C (SRL-131 only). Hydroxyl groups were found in the surface layers of all the glasses. In addition, molecular water was found in the surface of SRL-131 and PNL 76-68 glasses that had been leached for several months in deionized water, and in the vapor-hydrated sample. The water/hydroxyl ratio increases with increasing reaction time; molecular water makes up most of the hydrogen in the thick reaction layers on vapor-phase hydrated glass while only hydroxyl occurs in the least reacted samples. The hydrated layer on the nuclear waste glasses appears to be of relatively low water content (4 to 7% by weight) and is not substantially hydroxylated. Thus, these layers do not have many of the properties associated with gel layers.

40589 **Modelling of the dissolution of silicate glasses by a Monte-Carlo code (etch).** Dran, J.C.; Langevin, Y.; Doorhyee, E.; Petit, J.C. (CSNSM-CNRS, Orsay, France). pp 559-569 of Scientific basis for Nuclear Waste Management X. Bates, J.K.; Seefeldt, W.B. (eds.). Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—Pt.1).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

A Monte-Carlo code has been developed to infer dissolution rates of silicate glasses from their chemical composition. The glasses are considered as solid solutions of oxides and silicates, being divided into elementary cells of network formers, in which network modifiers can be incorporated. The different types of cells are randomly distributed and a resistance capacity to dissolution is assigned to each cell. They have tested the case where each cell is removed in a constant time as soon as it is in contact with the solution and a second one where each cell is dissolved in a time depending on the number of already dissolved neighbor cells. The first hypothesis leads to a percolation threshold when the proportion of fast etching cells reaches 25%. Above, the dissolution front progresses via contiguous channels of fast etching cells. In the second hypothesis the variations of the etch rate with the proportions of each component are much closer to a linear combination of individual etch rates. These predictions have been successfully compared to experimental data on different series of silicate glasses of increasing complexity. Such a treatment could be straightforwardly extended to nuclear glasses. 10 references, 8 figures.

40590 **Structural changes around uranium at the surface of waste glasses caused by leaching.** Barrett, N.T.; Antonini, G.M.; Thornley, F.R.; Greaves, G.N.; Manara, A. (Joint Research Center, Ispra, Italy). pp 571-576 of Scientific basis for Nuclear Waste Management X. Bates, J.K.; Seefeldt, W.B. (eds.). Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—Pt.1).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

Structural changes occurring at the surface of leached borosilicate glasses containing 3%wt of uranium have been investigated using fluorescence EXAFS spectroscopy at grazing incidence. X-ray penetration depths between 30 A and above 1000 A are possible by varying the incidence angle of the X-ray monochromatic radiation in the vicinity of the critical angle for total external reflection, phi/sub c/. This enables the surface and bulk structure to be compared. It is found that a local increase in uranium concentration takes place near the surface of the glass during the first 30 minutes of leaching time. Uranium is coordinated with oxygen and other uranium atoms. The local distribution can be modelled by a square planar island structure comprised of uranyl-type units. This structure changes with corrosion time. After 30 minutes of leaching there is evidence of partial removal of the surface layer. 9 references, 4 figures, 1 table.

40591 **Long-term corrosion behavior of copper-base materials in a gamma-irradiated environment.** Yunker, W.H.; Glass, R.S. (Westinghouse Hanford Co., Richland, WA). pp 579-590 of Scientific basis for Nuclear Waste Management X. Bates, J.K.; Seefeldt, W.B. (eds.). Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—Pt.1). Contract W-7405-ENG-48;AC06-76FF02170.

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

The US Department of Energy is currently evaluating the feasibility of using copper-base materials for the manufacture of nuclear waste containers. One site under consideration for geologic disposal of nuclear waste is at Yucca Mountain, Nevada. One feature of this waste repository will be the initial presence of ionizing gamma radiation at high dose rates, which may alter the corrosive medium. To evaluate such effects, three copper-base materials (pure copper, 7% aluminum-copper and 30% nickel-copper) have been exposed (presently up to 14 months) to a gamma radiation field of approximately 1 x 10^5 roentgens/hr. The exposure environments have been: (1) both groundwater (regional to the repository site, although taken from a lower elevation) at 95°C; (2) the water-vapor saturated air phase above it; and (3) air/water vapor at 150°C. In addition to uniform corrosion, both pitting and crevice corrosion have been observed. Characterization of the corrosion layers by X-ray diffraction has shown the presence of mixed copper(I) and copper(II) oxides. Studies by Auger Electron Spectroscopy (AES) have also been conducted in order to further characterize the compositions and structures of these corrosion products. 9 references, 9 figures, 6 tables.

40592 **Copper corrosion in irradiated environments. The influence of H_2O_2 on the electrochemistry of copper dissolution in HCl electrolyte.** Smyrl, W.H.; Bell, B.T.; Atanasoski, R.T.; Glass, R.S. (Univ. of Minnesota, Minneapolis). pp 591-601 of Scientific basis for Nuclear Waste Management X. Bates, J.K.; Seefeldt, W.B. (eds.). Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—Pt.1).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

The anodic dissolution of copper has been examined in deaerated, 0.1 M HCl aqueous solution in the presence of H_2O_2. Concentrations of H_2O_2 up to 0.2 M were studied at a rotating copper disk-platinum ring electrode. The open circuit potential (OCP) of copper was found to depend on both peroxide concentration and rotation rate. The OCP shifts towards more positive values with increasing H_2O_2 concentration (C) and decreasing rotation rate (Omega). The dependence of OCP on (C/Omega/sup 1/2/) was the same as for oxygenated solutions reported earlier [1], at small values of (C/Omega/sup 1/2/). At higher values of (C/Omega/sup 1/2/), departure from the expected behavior was observed. The current-voltage curves for anodic dissolution of copper were also influenced by the presence of peroxide. The curves recorded with the potential scanned in the positive direction showed the expected 60 mV slope, but the reverse scans showed significant departures. At a given potential scan rate, hysteresis was observed which was larger for higher H_2O_2 concentrations, lower rotation rates, and more positive anodic potential limits. Monitoring the cuprous ions at the outer Pt ring revealed that there was a complex set of events taking place at the copper surface, including film formation and the appearance of cupric ions. 13 references, 7 figures.

40593 **Radiolytically induced oxidation reactions of actinide ions in concentrated salt solutions.** Kim, J.I.; Lierse, C.; Bueppelmann, K.; Magirius, S. (Institut fuer Radiochemie, Garching, West Germany). pp 603-612 of Scientific basis for Nuclear Waste Management X. Bates, J.K.; Seefeldt, W.B. (eds.). Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—Pt.1).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

The autoradiolytic oxidation of Pu(IV) and Am(III) has been investigated in saline solution of different NaCl concentrations, pH and specific α-activities. The high linear energy transfer (LET) property of α-radiation in solution enhances the oxidation of the Cl^- ion and thus increases the redox potential (Eh) of the NaCl solution system to a value of more than +1000 mV vs. NHE. Radiolytic reaction products are found as being comparable with those from the Cl_2 saturated NaCl solution and create a metastable system consisting of Cl_2/HC10/C10$^-$/Cl$^-$. The oxidation of Pu(IV) and Am(III) in such solutions is dependent on the NaCl concentration, pH and specific α-activity involved. The quantitative oxidation to Pu(VI) and Am(V) is observed in the concentrated NaCl solution at pH > 7 with a moderately high specific activity (> 1 Ci/L). 22 references, 15 figures.

40594 **Effects of gamma radiation on groundwater chemistry and glass reaction in a saturated tuff environment.** Ebert, W.L.; Bates, J.K.; Gerding, T.J.; van Konynenburg, R.A. pp 613-622 of Scientific basis for Nuclear Waste Management X. Bates, J.K.; Seefeldt, W.B. (eds.). Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—Pt.1). Contract W-31-109-ENG-38.

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

The Nevada Nuclear Waste Storage Investigations project has completed a series of experiments that provide insight into groundwater chemistry and glass waste form performance in the presence of a gamma radiation field at 90°C. Results from experiments done at 1 x 10^3 and 0 R/hr are presented and compared to similar experiments done as 2 x 10^5 and 1 x 10^4 R/hr. The major effect of radiation is to lower the groundwater pH to a value near 6.4. The addition of glass to the system results in slightly more basic final pH, both in the presence and absence of radiation. However, there is essentially no difference in the extent of glass reaction, as measured by elemental release, as a function of dose rate or total dose, for reaction periods up to 278 days. 17 references, 7 figures.

40595 **Effects of gamma radiolysis on waste package components.** Lewis, M.A.; Reed, D.T. pp 623-634 of Scientific basis for Nuclear Waste Management X. Bates, J.K.; Seefeldt, W.B. (eds.). Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—Pt.1). Contract AC06-77RL01030.

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

Preliminary short-term experiments to study the effect of gamma radiation on the waste package materials interactions in the environment of a nuclear waste repository in basalt were completed. Experimental parameters were similar to those expected during the saturated post-closure period of the repository, i.e., a temperature of 200°C and a hydrostatic pressure of ≧ 70 bar. The test components included various combinations of synthetic groundwater (GR4), low carbon steel coupons, CH_4, basalt, and basalt/bentonite mixtures (packing). The tests were run in low carbon steel pressure vessels. It was found that gamma radiation at a dose rate of 10^4 rad/hr for a duration of one and two months increased the H_2 yield in all tests. Increases in the organic carbon yield, the sulfate ion concentration, and the corrosion rate of the coupon were observed in some of the tests. These latter results varied with the combination of waste package components included in the tests. Evidence for the quench effect was observed in tests which included basalt. 12 references, 6 figures, 2 tables.

40596 **Natural annealing of alpha-recoil damage in metamict minerals of the thorite group.** Eyal, Y.; Lumpkin, G.R.; Ewing, R.C. (Technion - Israel Institute of Technology, Haifa). pp 635-643 of Scientific basis for Nuclear Waste Management X. Bates, J.K.; Seefeldt, W.B. (eds.). Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—Pt.1). Contract FG04-84ER45099.

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

Minerals of the thorite ($ThSiO_4$) mineral group have been leached as fine powders in bicarbonate-carbonate solutions for time periods up to 288 days. The radioactivities of the solutions were measured for ^{238}U, ^{234}U, ^{232}Th, ^{230}Th and ^{228}Th by alpha spectrometry, preceded by chemical separation and purification of U and Th. The results confirm the preservation of disordered regions of higher chemical reactivity in an already fully-damaged aperiodic structure. The damage is most evident for the short-lived nuclide ^{228}Th and to a much lesser extent for the long-lived nuclide ^{234}U because the alpha-recoil tracks anneal with time. The calculated mean life of an alpha-recoil track in these metamict thorium silicates is approximately 1500 to 6000 years. This study demonstrates that alpha-decay products are selectively leached from damaged, aperiodic materials, but the damage is subject to low-temperature annealing over relatively short periods of time. 11 references, 2 figures, 2 tables.

40597 **X-ray absorption spectroscopy investigation of the Ta site in alpha-recoil damaged natural pyrochlores.** Greegor, R.B.; Lytle, F.W.; Chakoumakos, B.C.; Lumpkin, G.R.; Ewing, R.C.; Spiro, C.L.; Wong, J. (Boeing Co., Seattle, WA). pp 645-658 of Scientific basis for Nuclear Waste Management X. Bates, J.K.; Seefeldt, W.B. (eds.). Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—Pt.1). Contract FG06-84ER45121;FG04-84ER45099.

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

X-ray absorption spectroscopy has been used to investigate the Ta L/sub III/ and L/sub I/ absorption edges of metamict and annealed pyrochlore minerals A/sub 1-2/B_2O_6Y/sub 0-1/. The L/sub III/ edge absorption spectra exhibit a pronounced doublet in the primary absorption resonance for the annealed samples which have the pyrochlore structure. The doublet in the L/sub III/ edge resonance becomes less pronounced and for some samples even merges into a singlet for the samples in the unannealed, fully damaged (metamict) state. The L/sub III/ edge resonance of the damaged samples closely resembles Ta_2O_5 or disordered manganotantalite ($MnTaNbO_6$), while the L/sub III/ edge resonance for the annealed samples most closely resembles the synthetic pyrochlore $KTaWO_6$ x H_2O. These results are supported by the Ta L/sub I/ edge x-ray absorption data. Fourier transforms of the Ta L/sub III/ edge x-ray absorption fine structure (EXAFS) show first neighbor Ta-O bond lengths of 1.96 +/- 0.05 A for the samples in the annealed and metamict state. The complex structure of Ta_2O_5 is used as a model for the Ta-containing oxygen polyhedra in metamict pyrochlores, as it embodies some of the topologic features consistent with the reduction of long-range periodicity with increasing alpha-decay dose: (1) greater distortion of the primary coordination shell around Ta, (2) slightly increased mean second nearest-neighbor <Ta...X> distances, and (3) a wider distribution of second nearest-neighbor distances. These modifications are incorporated in a large unit cell with a b translation of ~ 40 A. 34 references, 10 figures, 1 table.

40598 **Radiation damage and its annealing in sodium silica glass.** Maerk, T.D.; Ritter, W. (Institut fuer Experimentalphysik, Innsbruck, Austria). pp 659-669 of Scientific basis for Nuclear Waste Management X. Bates, J.K.; Seefeldt, W.B. (eds.). Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—Pt.1).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

Annealing of radiation damage in artificial sodium silica glass has been studied by absorption spectroscopy for different radiation sources (fission fragments produced by n,f reactions, alpha decays produced by n, α reactions, and 2 MeV electrons) as a function of annealing time and temperature. The annealing observed can be described best by a single exponential function A(t) = a exp (- αt) with an Arrhenius type temperature dependence of the annealing coefficient α $\alpha(T) = \alpha_0$ exp (- E/sub A/kT). For the three different radiation sources similar activation energies E/sub A/ were deduced from the data. Possible annealing processes are discussed. 12 references, 5 figures, 1 table.

40599 **Generalized model for the radiolysis of groundwaters: bicarbonate chemistry and influences.** Nicolosi, S.L. (Battelle Memorial Institute, Columbus, OH). pp 671-679 of Scientific basis for Nuclear Waste Management X. Bates, J.K.; Seefeldt, W.B. (eds.). Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—Pt.1).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

A groundwater radiolysis model has been develcped at Battelle-Columbus which is applicable to groundwaters containing bicarbonate species. The model consists of a chemical mechanism which describes interactions between groundwater species and radiolytic species. Due to the chemical kinetics nature of the model, elementary reactions can be added to extend its range of applicability to other groundwaters. This paper describes the chemical kinetics and influences of bicarbonate species in the model. 23 references, 2 tables.

40600 **Views of the electric utility industry on the direction and progress of the Department of Energy's Nuclear Waste Program.** Mills, L.E. (Nuclear Activities, Edison Electric Institute). pp 1-15 of The high level waste business, transportation, storage and disposal. Bethesda, MD; Atomic Industrial Forum (1986). (CONF-861032—).

From High level waste business: transportation, storage and disposal; Charleston, SC, USA (19 Oct 1986).

The NWPA does provide guidance for a reasonable waste management program and one must work to implement it in an efficient and effective manner. It is well recognized that the lack of stability and predictability has been the bane of many nuclear reactor projects. The electric utilities are not satisfied with the progress of the nuclear waste program even though much has been achieved. DOE must continue in its struggle to seek a better balance between the technical, political and institutional aspects of the program to provide reasonable assurance that it will fulfill its contractual obligation with utilities.

40601 **Developments in the monitoring and control of Eh and pH conditions in hydrothermal experiments.** Myers, J.; Ulmer, G.C.; Grandstaff, D.E.; Brozdowski, R.; Danielson, M.J.; Koski, O.H. (Rockwell International, Rockwell Hanford Operations, Richland, WA 99352). pp 197-216 of Geochemical behavior of disposed radioactive waste. Barney, G.S.; Navratil, J.D.; Schulz, W.W. Washington, DC; American Chemical Society (1984). (CONF-830303—).

From 185. American Chemical Society national meeting; Seattle, WA, USA (20 Mar 1983).

In the design of a high-level nuclear waste repository it is essential to obtain accurate groundwater Eh-pH data. Design considerations such as the choice of matrix for the waste form, type and dimensions of canister material, use of buffers, and type and amount of backfill would all benefit from an exact knowledge of oxidation potentials (Eh) and acidity levels (pH) of the groundwater. The Basalt Waste Isolation Project (BWIP) has initiated a research effort to develop sensors which can be mounted in autoclaves to provide constant monitoring of the Eh-pH conditions that exist during waste form/barrier material/groundwater hydrothermal interaction tests. Sensors must withstand temperatures up to 300°C and pressures up to 300 bars. This report considers Teflon hydrogen diffusion membranes and zirconia pH sensors. The development of these sensors represents a significant advance in the environmental monitoring of Eh and pH conditions at elevated temperatures and pressures.

40602 **Preliminary assessment of oxygen consumption and Redox conditions in a nuclear waste repository in basalt.** Lane, D.L.; Jones, T.E.; West, M.H. (Rockwell International, Rockwell Hanford Operations, Richland, WA 99352). pp 181-196 of Geochemical behavior of disposed radioactive waste. Barney, G.S.; Navratil, J.D.; Schulz, W.W. Washington, DC; American Chemical Society (1984). (CONF-830303—).

From 185. American Chemical Society national meeting; Seattle, WA, USA (20 Mar 1983).

During construction of a nuclear waste repository in basalt (NWRB), Eh conditions in the repository horizon will be perturbed as a result of air-saturation of groundwater, temporarily leading to redox conditions more oxidizing than in the undisturbed system. Performance assessment of an NWRB requires information on redox conditions, since they will greatly affect the corrosion rate of canisters and the solubility and transport of certain radionuclides. Experiments were conducted to evaluate rates of oxygen consumption and redox conditions in the basalt-water system under conditions expected in an NWRB. These experiments have provided evidence that basalt is effective in removing dissolved oxygen and in rapidly imposing reducing conditions on solutions. At 300°C, calculations showed that an upper limit on Eh of -400 +- 100 mV was attained in 11 days. The dissolved oxygen content of solutions from a 150°C experiment decreased from air-saturation (8.5-9 mg/L) to 0.4 mg/L after 8 days, while solutions maintained at 100°C for 130 days contained 1.8-1.9mg/L dissolved oxygen.

40603 **Stability of tetravalent actinides in perovskites.** Williams, C.W.; Morss, L.R.; Choi, I.K. (Argonne National Lab., Chemistry Div., Argonne, IL 60439). pp 323-334 of Geochemical behavior of disposed radioactive waste. Barney, G.S.; Navratil, J.D.; Schulz, W.W. Washington, DC; American Chemical Society (1984). (CONF-830303—). Contract W-31-109-ENG-38.

From 185. American Chemical Society national meeting; Seattle, WA, USA (20 Mar 1983).

This paper reports the first determination of the enthalpy of formation of a complex actinide (IV) oxide: ΔH/sub f/° (BaUO/sub 3,s,/ 298 K) = -1690 +- 10 kJ mol/sup -1/. The preparation and properties of this and other actinide (IV) complex oxides are described and are compared with other perovskites BaMO/sub 3/. The relative stabilities of tetravalent and hexavalent uranium in various environments are compared in terms of the oxidation-reduction behavior of uranium in geological nuclear waste storage media; in perovskite, uranium (IV) is very unstable in comparison with uranium (VI).

40604 **Actinide and technetium sorption on iron-silicate and dispersed clay colloids.** Shade, J.W.; Ames, L.L.; Mc Garrah, J.E. (Pacific Northwest Lab., Richland, WA 99352). pp 67-78 of Geochemical behavior of disposed radioactive waste. Barney, G.S.; Navratil, J.D.; Schulz, W.W. Washington, DC; American Chemical Society (1984). (CONF-830303—).

From 185. American Chemical Society national meeting; Seattle, WA, USA (20 Mar 1983).

Two different colloidal suspensions, representative of those found in waste package interaction tests, were prepared from iron metal and silica powders or sodium-bentonite at 90°C. Aliquots were spiked with /sup 233/U, /sup 235/Np, /sup 237/Pu, or /sup 95m/Tc at pH ranges from 2 to 12, then shaken for 24 hours followed by a 15A filtration. Zeta potential measurements were made on unspiked samples. Similar sorptive properties were observed for both colloids. At 25°C both /sup 233/U and /sup 237/Pu exhibit maximum sorption (50-90%) near pH 6. Sorption drops by about a factor of 5 at pH >8. Slight sorption of /sup 235/Np occurs at pH 11 and decreases to zero at lower pH values. /sup 95m/Tc does not sorb on Fe-silicates and is only slightly sorbed (10%) on smectities.

40605 **Adsorption of nuclides on hydrous oxides: Sorption isotherms on natural materials.** Meyer, R.E.; Palmer, D.A.; Arnold, W.D.; Case, F.I. (Oak Ridge National Lab., Oak Ridge, TN 37830). pp 79-94 of Geochemical behavior of disposed radioactive waste. Barney, G.S.; Navratil, J.D.; Schulz, W.W. Washington, DC; American Chemical Society (1984). (CONF-830303—). Contract W-7405-ENG-26.

From 185. American Chemical Society national meeting; Seattle, WA, USA (20 Mar 1983).

Hydrous oxides and minerals which have adsorbing groups that behave like hydrous oxides are ubiquitous components of geological formations and may dominate the adsorptive properties of the formations at conditions of natural groundwaters. An understanding of the adsorptive behavior of hydrous oxides is therefore necessary for reliable prediction of migration of nuclides through the formations. Various isotherms are derived from equilibrium ion-exchange theory for the sorption of non-hydrolyzed ions on hydrous oxides. These isotherms are compared with experimental isotherms for sorption of Cs/sup +/, Sr/sup 2+/, Eu/sup 3+/, and TcO/sub 4//sup -/ on several hydrous oxides. General features of these isotherms are predictable from ion-exchange equilibrium theory as applied to hydrous oxides. By combining isotherms for hydrous oxides with those for layer-type clay minerals, many unusual features of isotherms found on geological materials can be explained.

40606 **Characterization of borosilicate glass-containing Savannah River Plant radioactive waste: MCC-1 tests and durability in geologic repository groundwaters.** Bibler, N.E. (E.I. du Pont de Nemours and Co., Savannah River Lab., Aiken, SC 29808). pp 359-372 of Geochemical behavior of disposed radioactive waste. Barney, G.S.; Navratil, J.D.; Schulz, W.W. Washington, DC; American Chemical Society (1984). (CONF-830303—). Contract AC09-76SR00001.

From 185. American Chemical Society national meeting; Seattle, WA, USA (20 Mar 1983).

Results are presented from static leach tests on borosilicate glass containing high-level radioactive nuclear waste from the Savannah River Plant. Tests were performed in shielded facilities closely following MCC-1 procedures. Leachants were deionized water, MCC brine, or silicate water, all at 40°C. Normalized mass loses (g/m/sup 2/) based on /sup 137/Cs, /sup 90/Sr, and /sup 238/Pu were calculated. Results of leach times of 3, 7, 14, 28, and 300 days are reported for deionized water. Results for 28 and 200 days are reported for silicate water and brine. Normalized mass losses and pH changes indicate that glass containing radioactive waste leaches similarly to glass containing nonradioactive, simulated waste. Results of the long-term tests suggest that equilibrium concentrations of radionuclides will be achieved. Based on tests with different ratios of glass surface area to leachant volume, these concentrations are controlled more by solubility and surface layer effects than by the surface area of the glass.

40607 **Chemical and physical consequences of α and β/ sup -/ decay in the solid state.** Young, J.P.; Haire, R.G.; Peterson, J.R.; Ensor, D.D. (Oak Ridge National Lab., Transuranium Research Lab., Oak Ridge, TN 37830). pp 335-348 of Geochemical behavior of disposed radioactive waste. Barney, G.S.; Navratil, J.D.; Schulz, W.W. Washington, DC; American Chemical Society (1984). (CONF-830303—). Contract W-7405-ENG-26.

From 185. American Chemical Society national meeting; Seattle, WA, USA (20 Mar 1983).

Interesting chemical and structural phenomena can occur when radioactive materials are stored in the solid state. Extensive studies have been made of both the chemical and physical status of progeny species that result from the α or β decay of actinide ions in several different compounds. The samples have been both initially pure actinide compounds - halides, oxides, etc. - and actinides incorporated into other non-radioactive host materials, for example lanthanide halides. In general, the oxidation state of the actinide progeny is controlled by the oxidation state of its parent (a result of heredity). The structure of the progeny compound seems to be controlled by its host (a result of environment). In this paper conclusions are drawn from solid state absorption spectral studies, and where possible, from x-ray diffraction studies of multi-microgram sized samples.

40608 **Interaction of groundwater and basalt fissure surfaces and its effect on the migration of actinides.** Vandegrift, G.F.; Bowers, D.L.; Gerding, T.J.; Fried, S.M.; Wilbur, C.K.; Seitz, M.G. (Argonne National Lab., Argonne, IL 60439). pp 229-250 of Geochemical behavior of disposed radioactive waste. Barney, G.S.; Navratil, J.D.; Schulz, W.W. Washington, DC; American Chemical Society (1984). (CONF-830303—).

From 185. American Chemical Society national meeting; Seattle, WA, USA (20 Mar 1983).

Experiments are being performed at Argonne National Laboratory (ANL) to identify interactions of radionuclides and repository components that effect nuclide migration; and to assess changes in nuclide migration caused by modifications expected upon aging of the waste, backfill, and rock. This paper describes the philosophy of these experiments, the experimental set up, and some early results of this effort. The experiments are conducted with radioactive borosilicate glass, bentonite and mechanically fissured basalt rock in flowing water analogous to their configuration in a breach of a nuclear waste repository. Changes undergone by the groundwater as it passed through the fissure include - drop in pH from 10 to 8; loss of suspended particulate; and loss of dissolved/suspended U, Np, and Pu. These effects, also studied as functions of radiation dose and of laboratory "aging" of the repository components, are related to the predicted long-term performance of a nuclear waste repository.

0530 Environmental Aspects

REFER ALSO TO CITATION(S) 40509, 40510, 40511, 40512, 40542, 40564, 40565, 40580, 40606, 40608, 40655, 40660, 41928, 41974, 41976

40609 **(FMPC—2082) History of FMPC radionuclide discharges.** Boback, M.W.; Dugan, T.A.; Fleming, D.A.; Grant, R.B.; Keys, R.W. (Westinghouse Materials Co. of Ohio, Cincinnati (USA). Feed Materials Production Center). May 1987. Contract AC05-86OR21600. 211p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE87010205.

This report presents information on the discharge of radionuclides from the Feed Materials Production Center. Discharges to both air and water have occurred but airborne releases are emphasized because inhalation is the principal potential exposure route for most offsite residents in the FMPC area. Information in this report was compiled in response to a DOE request for a history of radionuclide discharges during the 34 years of FMPC operations from 1951 through 1984. DOE desired that best estimates be made when sampling data were not available to provide a complete history. This approach applied most directly to airborne uranium discharges because of the relative importance of the airborne pathway in regard to radiation doses to offsite population groups. Therefore, for those periods when stack emission data were not available, reasonable estimates were made. Most of these estimates were made by extrapolating from periods when emissions were measured or they were derived from measured production - discharge ratios applied to periods for which only production data were available.

40610 **(KAPL—4196) Knolls Atomic Power Laboratory annual environmental monitoring report, calendar year 1986.** (Knolls Atomic Power Lab., Schenectady, NY (USA)). 1986. Contract AC12-76SN00052. 64p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87012989.

The results of the effluent and environmental monitoring programs at the three Knolls Atomic Power Laboratory (KAPL) sites are summarized and assessed in this report. Operations at the three KAPL sites resulted in no significant release of hazardous substances or radioactivity to the environment. The effluent and environmental monitoring programs conducted by KAPL are designed to determine the effectiveness of treatment and control methods, to provide measurement of the concentrations in effluents for comparison with applicable standards, and to assess resultant concentrations in the environment. The monitoring programs include analyses of samples of liquid and gaseous effluents for chemical constituents and radioactivity as well as monitoring of environmental air, water, sediment, and fish. Radiation measurements are also made around the perimeter of each site and at off-site background locations. 40 refs., 9 figs., 20 tabs.

40611 **(RHO-HS-ST—11) PUREX and UO_3 Plants nitrogen oxides emissions: Fourth quarter 1983 through third quarter 1986.** Hutchison, D.P. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Apr 1987. Contract AC06-77RL01030. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012723.

This document summarizes the nitrogen oxides (NO/sub x/) emissions from the Plutonium Uranium Extraction (PUREX) Plant and Uranium Oxide (UO_3) Plant from the fourth quarter of 1983 (restart of the PUREX Plant) through the third quarter of 1986. The Prevention of Significant Deterioration (PSD) permit number PSD-X80-14 establishes limits for the discharge of NO/sub x/ from PUREX and UO_3 facilities. This document includes a comparison of the emissions to the established limits.

40612 Materials interactions relating to long-term geologic disposal of nuclear waste glass. Bibler, N.E.; Jantzen, C.M. (E.I. du Pont de Nemours & Co., Aiken, SC). pp 47-66 of Scientific basis for Nuclear Waste Management X. Bates, J.K.; Seefeldt, W.B. (eds.). Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—Pt.1). Contract AC09-76SR00001.

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

In the geologic disposal of nuclear waste glass, the glass will eventually interact with groundwater in the repository system. Interactions can also occur between the glass and other waste package materials that are present. These include the steel canister that holds the glass, the metal overpack over the canister, backfill materials that may be used, and the repository host rock. This review paper systematizes the additional interactions that materials in the waste package will impose on the borosilicate glass waste form-groundwater interactions. The repository geologies reviewed are tuff, salt, basalt, and granite. The interactions emphasized are those appropriate to conditions expected after repository closure, e.g. oxic vs anoxic conditions. Whenever possible, the effect of radiation from the waste form on the interactions is examined. The interactions are evaluated based on their effect on the release and speciation of various elements including radionuclides from the glass. It is noted when further tests of repository interactions are needed before long-term predictions can be made. 63 references, 1 table.

40613 Natural analogues: their application to the prediction of the long-term behavior of nuclear waste forms. Ewing, R.C.; Jercinovic, M.J. (Univ. of New Mexico, Albuquerque). pp 67-83 of Scientific basis for Nuclear Waste Management X. Bates, J.K.; Seefeldt, W.B. (eds.). Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—Pt.1).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

One of the unique and scientifically most difficult aspects of nuclear waste isolation is the extrapolation of short-term laboratory data (hours to years) to the long time periods (10^3-10^5 years) required by regulatory agencies for performance assessment. The direct verification of these extrapolations is not possible, but methods must be developed to demonstrate compliance with government regulations and to satisfy the lay public that there is a demonstrable and reasonable basis for accepting the long-term extrapolations. Natural analogues of both the repository environment (e.g. radionuclide migration at Oklo) and nuclear waste form behavior (e.g. alteration of basaltic glasses and radiation damage in minerals) have been used to demonstrate the long-term behavior of large scale geologic systems and, on a smaller scale, waste form durability. This paper reviews the use of natural analogues to predict the long-term behavior of nuclear waste form glasses. Particular emphasis is placed on the inherent limitations of any conclusions that are based on proof by analogy. An example - corrosion of borosilicate glass - is discussed in detail with specific attention to the proper and successful use of natural analogues (basaltic glass) in understanding the long-term corrosion behavior of borosilicate glass. 64 references, 3 figures, 1 table.

40614 Spent fuel as a waste form - data needs to allow long term performance assessment under repository disposal conditions. Oversby, V.M. (Lawrence Livermore National Lab., CA). pp 87-101 of Scientific basis for Nuclear Waste Management X. Bates, J.K.; Seefeldt, W.B. (eds.). Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—Pt.1). Contract W-7405-ENG-48.

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

Performance assessment calculations are required for high level waste repositories for a period of 10,000 years under NRC and EPA regulations. In addition, the Siting Guidelines (10CFR960) require a comparison of sites following site characterization and prior to final site selection to be made over a 100,000 year period. In order to perform the required calculations, a detailed knowledge of the physical and chemical processes that affect waste form performance will be needed for each site. While bounding calculations might be sufficient to show compliance with the requirements of 10CFR60 and 40CFR191, the site comparison for 100,000 years will need to be based on expected performance under site specific conditions. The only case where detailed knowledge of waste form characteristics in the repository would not be needed would be where radionuclide travel times to the accessible environment can be shown to exceed 100,000 years. This paper will review the factors that affect the release of radionuclides from spent fuel under repository conditions, summarize their present state of knowledge, and suggest areas where more work is needed in order to support the performance assessment calculations. 17 references, 5 figures, 4 tables.

40615 Oxidation of CANDU fuel by the products of the alpha radiolysis of groundwater. Sunder, S.; Shoesmith, D.W.; Johnson, L.H.; Wallace, G.J.; Bailey, M.G.; Snaglewski, A.P. (Atomic Energy of Canada Ltd., Pinawa, Manitoba). pp 103-113 of Scientific basis for Nuclear Waste Management X. Bates, J.K.; Seefeldt, W.B. (eds.). Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—Pt.1).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

The oxidation of CANDU fuel by the products of alpha radiolysis of water is being investigated using X-ray Photoelectron Spectroscopy and electrochemical techniques. Possible mechanisms of oxidation of UO_2 by O_2 and H_2O_2, two of the oxidants formed during radiolysis of water, are discussed. Oxidation by H_2O_2 depends upon its concentration and the pH of the solution. The oxidation of UO_2 by the products of alpha radiolysis of water, formed by an alpha flux comparable with that expected at the used-fuel surface at the estimated time of waste container failure, caused very little dissolution of UO_2 fuel. The presence of reductants in groundwater reaching the fuel surface will diminish the fuel oxidation by the radiolysis products. 19 references, 8 figures.

40616 Radiation induced dissolution of UO_2. Christensen, H.; Bjergbakke, E. (Studsvik Energiteknik AB, Nykoeping, Sweden). pp 115-122 of Scientific basis for Nuclear Waste Management X. Bates, J.K.; Seefeldt, W.B. (eds.). Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—Pt.1).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

A model for the radiation induced dissolution of UO_2 has been developed and tested using experiments described in the literature. The model makes use of computer calculations based on a reaction mechanism in which the dissolution is initiated by reactions of H_2O_2, OH and HO_2 radicals with the UO_2 surface. The model gave a fair agreement between calculated and experimental results: for a dose rate of 400 rad/s the calculated yields of oxidation were 2.6 and 2.1 % x h^{-1} x m^{-2} after 1 and 2 h, respectively. The corresponding experimental yields were 1.9 and 1.5 % x h^{-1} x m^{-2}, when corrected for dissolution without irradiation. The effect of various initial concentrations of H_2O_2 has been tested, and a reasonable rate constant for the reaction of UO_2 and H_2O_2 has been found. The requirement for the rate constant is that H_2O_2 begins to be effective above concentrations of 10^{-3} mol x dm^{-3} in accordance with experiments by L. Johnson. 9 references, 1 figure, 4 tables.

40617 Experimental study of the dissolution of spent fuel at 85°C in natural ground water. Wilson, C.N.; Shaw, H.F. (Westinghouse Hanford Co., Richland, WA). pp 123-130 of Scientific basis for Nuclear Waste Management X. Bates, J.K.; Seefeldt, W.B. (eds.). Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—Pt.1).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

Semi-static dissolution tests using pressurized water reactor spent fuel rod segments and NNWSI reference J-13 well water in sealed stainless steel vessels at 85°C are being conducted in support of the Waste Package Task of the NNWSI Project. Test specimens include: bare fuel plus the empty cladding hulls, fuel rod segments with artificially induced cladding defects and water-tight end caps, and undefected fuel rod segments with water-tight end caps. The test conditions approximate those expected in the proposed NNWSI Project repository when the waste package has cooled sufficiently

to allow water to enter a breached container and contact the fuel rods, some of which may exhibit various degrees of cladding failure. Periodic solution samples (unfiltered and filtered) were analyzed for most radionuclides for which cumulative release limits are listed by the US Environmental Protection Agency. Results from the first six-month cycle of the 85°C tests are presented and are compared with results from the first cycle of a previous test series run at 25°C in fused silica test vessels. 5 references, 5 figures, 6 tables.

40618 **Transient and steady-state radionuclide transport through penetrations in nuclear waste containers.** Chambre, P.L.; Lee, W.W.L.; Kim, C.L.; Pigford, T.H. (Lawrence Berkeley Lab., CA). pp 131-140 of Scientific basis for Nuclear Waste Management X. Bates, J.K.; Seefeldt, W.B. (eds.). Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—Pt.1).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

In this paper they analyze the transport of radionuclides through penetrations in nuclear waste containers. Penetrations may result from corrosion or cracks and may occur in the original container material, in degraded or corroded material, or in deposits of corrosion products. They do not consider how these penetrations occur or the characteristics of expected penetrations in waste containers. They are concerned only with the analytical formulation and solutions of equations to predict rates of mass transfer through penetrations of specified size and geometry. Expressions for the diffusive mass transfer rates through apertures are presented. They present numerical illustrations for steady-state mass-transfer rates through a circular hole, including concentration isopleths. The results are extended to multiple holes, including a criterion for hole spacing wherein superposition of single-hole solutions can be used. Results illustrated for holes in thin-walled containers show that significant mass transfer can occur even if a small fraction of the container area is perforated. They also illustrate the case of holes facing a water gap, instead of being in intimate contact with porous rock. In this case the radionuclide flux from many small holes approaches that from a bare waste cylinder. 4 references, 5 figures.

40619 **Comparison of uranium release from spent fuel and unirradiated UO_2 in salt brine.** Gray, W.J. (Pacific Northwest Lab., Richland, WA). pp 141-152 of Scientific basis for Nuclear Waste Management X. Bates, J.K.; Seefeldt, W.B. (eds.). Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—Pt.1). Contract AC06-76RL01830.

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

Spent fuel and unirradiated UO_2 were previously reported [1] to have exhibited a 100-fold difference in the total amount of uranium released during static leach tests in salt brine. Two additional studies designed to investigate that difference have now been completed. The first study involved leach tests with UO_2 pellets that had been doped with plutonium to simulate the alpha activity in spent fuel. The second study consisted of leach tests on spent fuel specimens that originated in the same reactor assembly as those used in previous tests but handled differently following discharge from the reactor. Results from the recently completed tests show that at least 90% of the reported difference between the dissolution behavior of spent fuel and UO_2 can be attributed to an apparent surface oxidation of the spent fuel specimens after their discharge from the reactor. The effect of alpha radiolysis on the leaching of spent fuel and UO_2 in salt brine in the presence of an air atmosphere was found to be relatively small in these tests. 8 references, 5 figures, 1 table.

40620 **Determination of the solubility of amorphous UO_2(s) and the mononuclear hydrolysis constants of uranium(IV) at 25°C.** Bruno, J.; Casas, I.; Lagerman, B.; Munoz, M. (Royal Institute of Technology, Stockholm, Sweden). pp 153-160 of Scientific basis for Nuclear Waste Management X. Bates, J.K.; Seefeldt, W.B. (eds.). Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—Pt.1).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

The authors have measured the solubility of amorphous UO_2 in a wide pH range (2 to 10.5), in 0.5 M $NaClO_4$, at T = 25°C. The species responsible for the solubility are $U(OH)^+$ and $U(OH)_4$, with the stability constants $\log \beta_{13} = -1.1 +/- 0.1$ and $\log \beta_{14} = -5.4 +/- 0.2$, respectively. No evidence for $U(OH)_5^-$ is found up to pH = 10.5. The same model explains satisfactorily the solubility data obtained by Parks and Pohl(5) at T = 100°C, in the pH range 1 to 10. The measured solubility of amorphous UO_2(s) in the pH range 6 to 10.5, under reducing conditions, is rather high, U(IV) = $5\ 10^{-4}$ mols/l. This is in good agreement with previous data of Gayer and Leider(6) and Galkin and Stepanov(9). 17 references, 3 figures.

40621 **Solids characterization from hydrothermal tests with spent fuel.** Uziemblo, N.H.; Thomas, L.E.; Schoenlein, L.H.; Mastel, B.; Jenson, E.D. (Westinghouse Hanford Co., Richland, WA). pp 161-171 of Scientific basis for Nuclear Waste Management X. Bates, J.K.; Seefeldt, W.B. (eds.). Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—Pt.1).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

Reacted solids from 200°C, 25 MPa tests with spent light water reactor fuel and other component materials of a high-level nuclear waste repository in basalt were analyzed by scanning electron microscopy, X-ray powder diffractometry, transmission electron diffraction, Auger electron spectrometry, and microautoradiography. The work complements solutions analysis from the same tests conducted in Dickson-type rocking autoclaves for the Basalt Waste Isolation Project. Spent fuel reacted very slowly in fuel/water tests, exhibiting noticeable grain boundary etching and uranium silicate formation only after six months. Particle abrasion in the rocking autoclave produced fuel fines that remained apparently unaltered. In spent fuel tests with basalt or basalt and steel, iron smectite clay formed at the expense of mesostasis phases in the basalt. Low concentrations of β-emitters, probably Cs and Tc released from grain boundaries in the fuel, were incorporated in the clay. Steel corroded very slowly under the low-oxygen conditions of the tests, forming minor amounts of magnetite, hematite and wustite. The sluggishness of spent fuel/water and steel/water reactions is attributed to limited availability of oxygen under the test conditions. 13 references, 8 figures, 1 table.

40622 **Laser photoacoustic spectroscopy for trace level detection of actinides in groundwater.** Doxtader, M.M.; Maroni, V.A.; Beitz, J.V.; Heaven, M. pp 173-184 of Scientific basis for Nuclear Waste Management X. Bates, J.K.; Seefeldt, W.B. (eds.). Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—Pt.1). Contract W-31-109-ENG-38;AC06-77RL01030.

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

The Basalt Waste Isolation Project (Rockwell Hanford Operations-BWIP) is investigating the feasibility of building a repository in the Columbia River Basalts for the permanent disposal of high-level nuclear chemical behavior of radionuclides in the near-field environment of the waste container. Such information is needed to determine radionuclide release rates from the waste package and to make long-term projections of repository performance. To accomplish this task, ultrasensitive laser-based techniques, such as laser photoacoustic spectroscopy (LPAS) and laser induced fluorescence (LIF), are being developed as analytical methods for the trace-level detection and speciation of actinides in solutions typical of those encountered in groundwaters near the BWIP repository. In this paper we examine the utility of the LPAS technique for elucidating the chemical behavior of species present in the near-field environment of the BWIP repository. The authors briefly review the existing basis for interpreting actinide spectra at low concentrations, and describe our initial experiments. These experiments include development and demonstration of the methodology under optimum conditions, e.g., stable, well-characterized solutions of holmium; and application of the technique to conditions relevant to the repository, including studies performed with uranium in synthetic groundwater and at elevated temperatures.

40623 **Carbon-14 in waste packages for spent fuel in a tuff repository.** van Konynenburg, R.A.; Smith, C.F.; Culham, H.W.; Smith, H.D. (Lawrence Livermore National Lab., CA). pp 185-196 of Scientific basis for Nuclear Waste Management X. Bates, J.K.; Seefeldt, W.B. (eds.). Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—Pt.1). Contract W-7405-ENG-48.

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

Carbon-14 is produced naturally by cosmic ray neutrons in the upper atmosphere. It is also produced in nuclear reactors, in amounts much smaller than the global inventory. About one-thirds of this is released directly to the atmosphere, and the other two-thirds remains in the spent fuel. Both the Environmental Protection Agency and the Nuclear Regulatory Commission have established limits on release of the ^{14}C in spent fuel. This is of particular concern for the proposed repository in tuff, because of the unsaturated conditions and the consequent possibility of gaseous transport of ^{14}C as CO_2. Existing measurements and calculations of the ^{14}C inventory in spent fuel are reviewed. The physical distribution and chemical forms of the ^{14}C are discussed. Available data on the release of ^{14}C from spent fuel in aqueous solutions and in gaseous environments of air, nitrogen, and helium are reviewed. Projected ^{14}C behavior in a tuff repository is described. It is concluded that ^{14}C release measurements from spent fuel into moist air at temperatures both above and below the in situ boiling point of water as well as detailed transport calculations for the tuff geological environment will be needed to determine whether the 10CFR60 and 40CFR191 requirements can be met. 56 references, 1 table.

40624 **Statistical issues in pitting corrosion of carbon steel.** McNeil, M.B. (Nuclear Regulatory Commission, Washington, DC). pp 199-214 of Scientific basis for Nuclear Waste Management X. Bates, J.K.; Seefeldt, W.B. (eds.). Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—Pt.1).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

A review is given of the state of understanding of the statistical distributions of pit depths and pit populations in carbon steel, with special reference to underground carbon steel structures, which appear to bear significant similarities to the alloys and conditions expected in basalt and salt high level waste repositories. The data base on pit depth distributions is reviewed and the various phenomenological equations which have been used to rationalize laboratory and field observations are discussed and classified in terms of the statistical models underlying them. The present state of understanding of the physical phenomena underlying these distributions is reviewed, and suggestions for appropriate future research are presented. 15 figures.

40625 **MCC corrosion tests at reference testing conditions for A27 cast steel in Hanford ground water.** Merz, M.D.; Gerber, F.; Wang, R. (Pacific Northwest Lab., Richland, WA). pp 215-226 of Scientific basis for Nuclear Waste Management X. Bates, J.K.; Seefeldt, W.B. (eds.). Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—Pt.1). Contract AC06-76RL01830.

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

The Materials Characterization Center (MCC) at Pacific Northwest Laboratory is performing three kinds of corrosion tests for the Basalt Waste Isolation Project (BWIP) to establish the interlaboratory reproducibility and uncertainty of corrosion rates of container materials for high-level nuclear waste. The three types of corrosion tests were selected to address two distinct conditions that are expected in a repository constructed in basalt. An air/steam test is designed to address corrosion during the operational period and static pressure vessel and flowby tests are designed to address corrosion under conditions that bound the conditions during the post-closure period of the repository. The results of tests at reference testing conditions, which were defined to facilitate interlaboratory comparison of data, are presented. Data are reported for the BWIP/MCC-105.5 Air/Steam Test, BWIP/MCC-105.1 Static Pressure Vessel, and BWIP/MC-105.4 Flowby Test. In those cases where data are available from a second laboratory, a statistical analysis of interlaboratory results is reported and expected confidence intervals for mean corrosion rates are given. Other statistical treatment of data include analyses of the effects of vessel-to-vessel variations, test capsule variations for the flowby test, and oven-to-oven variations for air/steam tests. 5 references, 4 figures, 9 tables.

40626 **Approach for evaluating the general and localized corrosion of carbon-steel containers for nuclear waste disposal.** Marsh, G.P.; Taylor, K.J.; Sharland, S.M.; Tasker, P.W. (Harwell Lab., Oxfordshire, England). pp 227-238 of Scientific basis for Nuclear Waste Management X. Bates, J.K.; Seefeldt, W.B. (eds.). Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—Pt.1).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

The paper considers the long term corrosion of carbon-steel containers for heat generating nuclear waste in a granitic repository. Under such conditions carbon steel may exhibit general, localized or passive corrosion behavior depending on the exact composition and redox potential of the groundwater contacting the containers; localized corrosion being of most concern because it has the fastest propagation rate. It is well established, however, that such localized corrosion is only possible when the environment is sufficiently oxidizing to maintain a positive potential gradient between the cathodic surface and the corrosion sites, which requires that species with oxidizing potentials greater than water need to be present. This fact provides a basis for estimating the periods during which containers may be subject to localized and subsequently to general corrosion, and hence for making an overall assessment of the metal allowance required for a specified container life. A model for the diffusion transport of oxygen has been developed, and a sensitivity analysis has shown that the period of possible localized attack is strongly dependent on the passive film leakage current, the radiation dose rate and the oxygen diffusion coefficient. 20 references, 5 figures.

40627 **Evaluation of the susceptibility of ASTM A216 grade WCA mild steel to stress corrosion cracking in simulated salt repository environments.** Pitman, S.G. (Pacific Northwest Lab., Richland, WA). pp 239-249 of Scientific basis for Nuclear Waste Management X. Bates, J.K.; Seefeldt, W.B. (eds.). Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—Pt.1). Contract AC06-76RL01830.

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

In current conceptual designs, a mild steel (ASTM A216 Grade WCA) is the reference container material for use in high level nuclear waste packages intended for emplacement in a salt repository. The resistance of the steel to stress corrosion cracking (SCC) is being investigated as part of the effort underway to verify the suitability of the material for waste package applications. Static tests (U-bend and bolt-loaded fracture toughness specimens) and dynamic tests (slow strain rate and corrosion fatigue) were conducted on both as-cast and weldment specimens of the material, in both low-Mg and high-Mg halite-saturated brines, in the temperature range of 90 to 200°C. The investigations indicate that the steel is not susceptible to SCC under the test conditions employed. 3 references, 2 figures, 4 tables.

40628 **Statistics of pit initiation: analysis of current transients during passive film breakdown.** Bertocci, U.; Leigh, S.; Van Orden, A.C.; Yang, G. (National Bureau of Standards, Gaithersburg, MD). pp 251-259 of Scientific basis for Nuclear Waste Management X. Bates, J.K.; Seefeldt, W.B. (eds.). Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—Pt.1).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

During the incubation period preceding pitting, current fluctuations indicate the beginning of the breakdown of the passive film. The characteristics of these current transients are being examined as a possible way to predict pitting. Stochastic models applied to the breakdown process have been proposed, and in order to test how well they account for the experimental results, various forms of processing of the current vs. time records are necessary. This paper describes the experimental data-taking methods, the processing routines so far developed for the statistical analysis of the data,

and compares the experimental results with computer simulations based on a stochastic model. 4 references, 8 figures.

40629 **Metal-matrix corrosion studies in Canadian shield granitic groundwaters.** Mathew, P.M.; Krueger, P.A. (Atomic Energy of Canada Ltd., Pinawa, Manitoba). pp 261-270 of Scientific basis for Nuclear Waste Management X. Bates, J.K.; Seefeldt, W.B. (eds.). Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—Pt.1).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

The Canadian Nuclear Fuel Waste Management program is evaluating two basic supported-shell container concepts for used-fuel immobilization. One concept uses a compacted particulate material within the container to support a thin, corrosion-resistant shell. The other concept, called the metal-matrix concept, uses a cast-in-place metal matrix for shell support. This paper describes corrosion studies on the candidate matrix materials, lead, zinc and aluminum-7 wt.% Si (Al-7 wt.% Si), in the temperature range 293 to 423 K and the dissolved oxygen content range 8 to 410 mg/L. Test specimens were analyzed for general and localized corrosion and the corrosion products were identified. The results showed that, unlike lead, zinc and Al-7 wt.% Si are susceptible to localized corrosion. Lead showed only low general corrosion rates of 2 to 83 μm/a compared with zinc (36 to 15,800 μm/a) and Al-7 wt.% Si (6 to 209 μm/a) in the above temperature and oxygen content ranges. Maximum pit depths of about 0.9 mm on Al-7 wt.% Si and 0.6 mm on zinc were observed. These results indicate that, of the candidate matrix metals studied, lead has the greatest potential to retard radionuclide release from used-fuel disposal containers. 10 references, 7 figures, 2 tables.

40630 **Corrosion model for nuclear waste containers.** Walton, J.C.; Sagar, B. (Rockwell Hanford Operations, Richland, WA). pp 271-282 of Scientific basis for Nuclear Waste Management X. Bates, J.K.; Seefeldt, W.B. (eds.). Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—Pt.1).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

Theory of a mechanistic model for estimating the maximum rate of uniform corrosion for a steel or copper container in a saturated repository environment is described. Four oxidants that are considered are oxygen, sulfate, radiolysis products, and water. Rates of corrosion from oxygen and sulfate reduction are assumed limited by the rate of inward diffusion of the oxidant through the rock, packing, and corrosion product layers surrounding the container. Reduction of water is limited by kinetic processes as influenced by mass transfer of products and reactants, temperature, and pH. Substantial changes in the system resulting from the corrosion process are predicted to occur over time. 13 references, 5 figures, 2 tables.

40631 **Theoretical evaluation of localized corrosion in radioactive waste canisters.** Sharland, S.M. (Harwell Lab., Oxon, England). pp 283-293 of Scientific basis for Nuclear Waste Management X. Bates, J.K.; Seefeldt, W.B. (eds.). Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—Pt.1).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

Under repository conditions, it is likely that radioactive waste canisters will be subjected to both uniform and localized corrosion. Localized corrosion can take many forms depending on the precise physical and chemical environment of the metal at the time of attack, but generally the rates of penetration are much greater than those associated with uniform corrosion. The most likely forms under aerated repository conditions are pitting and crevice corrosion. To ensure adequate radionuclide containment an allowance for these rates must be included in the final canister dimensions. It is considered the best way to predict long term penetration rates is to develop mathematical models, which include all the physical and chemical processes necessary to describe the system and use experimentally determined input parameters relating to these processes. These models must then draw on further experimental data for validation over short timescales. In this paper, they discuss several techniques of modelling long term pit propagation in waste canisters. The complexity of the problem has lead to a number of physical and chemical approximations in the modelling. They investigate the applicability and ranges of validity of several of the more common approximations, both in their own models and in the literature, and compare the predictions with experimental pit growth rates. An investigation of the sensitivity of the models to the various empirical input parameters indicates which need to be determined most accurately. 15 references, 5 figures.

40632 **Corrosion behavior of container materials in Grande Ronde Basalt groundwater.** Anantatmula, R.P.; Fish, R.L. (Rockwell Hanford Operations, Richland, WA). pp 295-306 of Scientific basis for Nuclear Waste Management X. Bates, J.K.; Seefeldt, W.B. (eds.). Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—Pt.1). Contract AC06-77RL01030.

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

Three candidate waste package container materials were tested for 5 mo at 200°C in Hanford Site Grande Ronde Basalt groundwater (9.75 pH) under anoxic conditions (< 0.1 mg/L dissolved oxygen in water). The materials were cast carbon steel (American Society for Testing and Materials (ASTM) A27), wrought carbon steel (American Iron and Steel Institute (AISI) 1020), cupronickel 90-10, and Fe9Cr1Mo steel. Testing was performed in 1-L titanium autoclaves at a pressure of 6.9 MPa and a flow rate of ~ 0.02 mL/min. Anoxic conditions were achieved by constantly sparging the synthetic groundwater in the reservoir with argon. In addition, the groundwater was conditioned by placing a 2.54-cm layer of crushed basalt (~ 0.635 cm average size) at the bottom of each autoclave. The average corrosion rates at 200°C were 0.9 μm/yr for cupronickel 90-10 and Fe9Cr1Mo steel, 1.1 μm/yr for cast carbon steel, and 1.4 μm/yr for wrought carbon steel. Pitting was not detected in any of the specimens. Posttest analysis of the corrosion specimens indicated the formation of a thin film of iron smectite clay on the surface of all specimens. In addition, magnetite formation immediately adjacent to the specimen surface was observed in the iron-base alloys, consistent with previous investigations. Based on the present investigations, all the materials exhibited significantly lower corrosion rates than were used in the Environmental Assessment (~ 5 μm/yr [1] for calculating acceptable container lifetimes. However, longer term general corrosion tests and tests to study the container materials susceptibility to other degradation modes are necessary prior to making a final evaluation of the suitability of these materials for use in fabricating high-level nuclear waste containers. 16 references, 5 figures, 2 tables.

40633 **Effect of pore solution composition on cesium leachability of cement-based waste forms.** Hoyle, S.Q.; Grutzeck, M.W. (Pennsylvania State Univ., University Park). pp 309-317 of Scientific basis for Nuclear Waste Management X. Bates, J.K.; Seefeldt, W.B. (eds.). Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—Pt.1). Contract FG01-83NE44503;AC02-83ER45013;FG02-84ER45145.

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

The relationship of pore solution composition to observed leach behavior for cesium-doped, cement-based waste form has been demonstrated. A leaching model is proposed, based on early diffusion and homogenization of the pore solution and leachant followed by re-equilibration of the waste form with the greater pore solution (pore solution plus leachant) over the long term. 10 references, 6 figures, 3 tables.

40634 **Modelling porewater chemistry in hydrated Portland cement.** Berner, U.R. (Swiss Federal Institute for Reactor Research, Wurenlingen). pp 319-330 of Scientific basis for Nuclear Waste Management X. Bates, J.K.; Seefeldt, W.B. (eds.). Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—Pt.1).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

Extensive employment of concrete is foreseen in radioactive waste repositories. A prerequisite for modelling the interactions be-

tween concrete and formation waters is characterization of the concrete system. Available experimental data from high pressure squeezing of cement pore-water indicate that, besides the high pH due to alkali hydroxide dissolution, cement composition itself influences the solubility determining solid phases. A model which simulates the hydration of Portland cement assuming complete hydration of the main clinker minerals is presented. The model also includes parameters describing the reactions between the cement and blending agents. Comparison with measured pore-water data generally gives a consistent picture and, as expected, the model gives correct predictions for pure Portland cements. For blended cements, the required additional parameters can, to some extent, be derived from pore-water analysis. 14 references, 1 figure, 4 tables.

40635 **Solubility modelling of cements: implications for radioactive waste immobilization.** Glasser, F.P.; MacPhee, D.E.; Lachowski, E.E. (Univ. of Aberdeen, Scotland). pp 331-341 of Scientific basis for Nuclear Waste Management X. Bates, J.K.; Seefeldt, W.B. (eds.). Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—Pt.1).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

The suitability of cement matrices for the long-term immobilization of radionuclides cannot be predicted from short-term experimental data alone, because the chemical properties of cementitious systems change continuously over the repository lifetime. To model such changes is complex, so a stepwise approach has been adopted. A chemically simplified model for the solubility and compositional properties of calcium silicate hydrate gels in the system $CaO-SiO_2-H_2O$ was previously developed but has now been extended and is improved and is applicable to gels in the wider composition range $0.8 < Ca/Si < 1.7$. The effects of silicate speciation in aqueous solution on the formation of the solid phase have been more fully considered and the dissolution equilibrium has been revised. Solubility products and free energies of C-S-H formation have been evaluated and predictive applications of the model are discussed. 29 references, 6 figures, 2 tables.

40636 **Calculation of near-field radioactivity release rates from neutron-activated reactor parts in a shallow-land burial site at Oak Ridge National Laboratory.** Hightower, J.R.; Kelmers, A.D. (Oak Ridge National Lab., TN). pp 369-379 of Scientific basis for Nuclear Waste Management X. Bates, J.K.; Seefeldt, W.B. (eds.). Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—Pt.1).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

The purpose of this work was to estimate the near-field radioactivity release rates associated with the high-activity, low-level radioactive wastes currently emplaced in Solid Waste Storage Area 6 (SWSA-6) at Oak Ridge National Laboratory (ORNL). Examination of the existing records [1] showed that about 84% of the radioactivity emplaced in SWSA-6 could apparently be accounted for by neutron-activated metal parts discharged from the High Flux Isotope Reactor (HFIR); therefore, this analysis was limited to consideration of those HFIR wastes. The radionuclide inventory contained in the HFIR wastes was first calculated, and then realistic or conservative assumptions as well as existing data were employed to calculate near-field radionuclide release rates. The dominant uncertainties in the calculations were summarized, and the research which would be needed to reduce these uncertainties was described. A more complete description of this work can be found in reference [2]. 11 references, 5 figures, 3 tables.

40637 **Coupling of chemical and transport processes in near-field modelling.** Sharland, S.M.; Tasker, P.W.; Tweed, C.J. (Harwell Lab., Oxon, England). pp 683-694 of Scientific basis for Nuclear Waste Management X. Bates, J.K.; Seefeldt, W.B. (eds.). Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—Pt.1).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

Near-field modelling is concerned with the description of the migration, chemical and degradation processes that may occur within an engineered radioactive waste repository and its immediate environs. The object is to gain understanding of such processes in order to predict the long-time evolution of the repository and to assess the degree of containment provided by the proposed engineered construction. The conditions of primary interest to their program concern the waste contained within a steel canister and buried in a concrete environment within a clay geology. The chemistry of the near-field is controlled in that it is the consequence of the choice of near-field components, but it may be extremely complex. Intrusion of external groundwater and degradation of the chosen materials will lead to variations in the chemistry in both space and time. It is vitally important to understand these changing chemical conditions since they determine the solubility and sorption of any released radionuclides. In this paper, they describe the computer program CHEQMATE (CHemical EQuilibrium with Migration And Transport Equations), which has many applications in modelling various changes in chemistry in the near-field. The program combines an ionic migration code with the geochemical program PHREEQE [1]. The program maintains local chemical equilibrium in the system as the transport processes evolve. The program includes automatic mineral accounting; solid phases are added or removed from the equilibrium as precipitation or dissolution occurs. They illustrate the use of the CHEQMATE program with an example of a coupled chemical and transport problem, particularly relevant to the near-field of a waste repository. 6 references, 7 figures, 1 table.

40638 **Tc behavior in the basalt-synthetic groundwater system as a function of temperature and initial oxygen content.** Wood, M.I.; Ames, L.L.; McGarrah, J.E. (Rockwell Hanford Operations, Richland, WA). pp 695-702 of Scientific basis for Nuclear Waste Management X. Bates, J.K.; Seefeldt, W.B. (eds.). Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—Pt.1).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

Experiments have been completed in the basalt-Tc-doped groundwater system to quantify the mobility of Tc in the waste package and near field environment in a repository located in basalt. The experiments were completed using a batch sorption technique in which crushed basalt and Tc-doped groundwater were reacted at 85, 100, 125 and 150°C for periods of time up to 118 days. The water to rock ratio was 10:1 ml/g. In another set of experiments, basalt crushed under anoxic conditions and Tc-doped groundwater were reacted at 85°C at different water to rock ratios (10:3, 20:3, 40:3 and 80:3 ml/g). The rate and percentage of Tc removed from solution increased with increasing temperature and decreasing water to rock ratio. Also, basalt crushed under anoxic conditions removed $>$ 87% of Tc from solution at 85°C in 7 days while no Tc was removed from solution with basalt crushed in air at the same temperature after 118 days. These results are consistent with the hypothesis that (1) ferrous iron in basalt phases preferentially consumes oxygen and will not reduce Tc until all free oxygen in the system is consumed. Once oxygen is consumed, reduction of Tc is quite rapid. These data indicate that the potential exists in a basalt hydrothermal environment to satisfactorily immobilize Tc. Reliable application of these data will depend on experimental and theoretical estimates of oxygen consumption with time in the waste package environment following repository closure, subsequent saturation and long term hydrothermal reactions. 6 references, 4 figures, 2 tables.

40639 **Transport of uranium and technetium through the unsaturated tuffs, Yucca Mountain, Nevada.** Cederberg, G.A.; Greenwade, L.E.; Travis, B.J. (Los Alamos National Lab., NM). pp 703-712 of Scientific basis for Nuclear Waste Management X. Bates, J.K.; Seefeldt, W.B. (eds.). Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—Pt.1).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

An area containing unsaturated fractured tuffs at Yucca Mountain, Nevada, is one of the potential sites for geologic storage of high-level radioactive waste. The Environmental Protection Agency (EPA) 40 CFR 191 Regulation limits the cumulative releases of many radionuclides from the repository to the accessible environment for 10,000 years after disposal [1]. Numerical models can be used to determine if the EPA containment requirement is met. In this paper a preliminary set of transport calculations for

uranium and technetium is discussed. First, a foundation for the calculations, a comprehensive, referenced geochemical/geophysical model containing the current stratigraphic, petrologic, hydrogeologic, geochemical, and material data for the Yucca Mountain site was compiled. Second, the integrated transport of uranium and technetium from the repository to the water table was modeled. An expected-case flow scenario and a worse-case flow scenario were used in the calculations. The sorption of technetium was neglected in the worse-case scenario. Results show that in the case of uranium, the estimated transport was only moderately sensitive to the magnitude of the flow because sorption had a significant effect on the retardation. In the case of technetium, when sorption was neglected, the flow dominated the transport. The EPA containment requirements were met for all cases. These preliminary calculations will be used as a basis to investigate the effects of physical and geochemical processes on the long-term transport of radionuclides at Yucca Mountain. 18 references, 4 figures, 3 tables.

40640 **Simulation of uranium transport with variable temperature and oxidation potential: the computer program THCC.** Carnahan, C.L. (Lawrence Berkeley Lab., CA). pp 713-721 of Scientific basis for Nuclear Waste Management X. Bates, J.K.; Seefeldt, W.B. (eds.). Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—Pt.1). Contract AC03-76SF00098.

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

A simulator of reactive chemical transport has been constructed with the capabilities of treating variable temperatures and variable oxidation potentials within a single simulation. Homogeneous and heterogeneous chemical reactions are simulated at temperature-dependent equilibrium, and changes of oxidation states of multivalent elements can be simulated during transport. Chemical mass action relations for formation of complexes in the fluid phase are included explicitly within the partial differential equations of transport, and a special algorithm greatly simplifies treatment of reversible precipitation of solid phases. This approach allows direct solution of the complete set of governing equations for concentrations of all aqueous species and solids affected simultaneously by chemical and physical processes. Results of example simulations of transport, along a temperature gradient, of uranium solution species under conditions of varying pH and oxidation potential and with reversible precipitation of uraninite and coffinite are presented. The examples illustrate how inclusion of variable temperature and oxidation potential in numerical simulators can enhance understanding of the chemical mechanisms affecting migration of multivalent waste elements. 22 references, 2 figures, 1 table.

40641 **Irreversibility of Se(VI)/Se(IV) redox couple in synthetic basaltic ground water at 25°C and 75°C.** Runnells, D.D.; Lindberg, R.D.; Kempton, J.H. (Univ. of Colorado, Boulder). pp 723-733 of Scientific basis for Nuclear Waste Management X. Bates, J.K.; Seefeldt, W.B. (eds.). Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—Pt.1).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

Synthetic basaltic ground water was spiked with different ratios of high-purity sodium selenate and sodium selenite, to yield ratios of aqueous SeO_4^{2-} to SeO_3^{2-} from 2100/1 to 1/44,000, at temperatures of 25°C and 75°C. The apparent Eh of the solutions was measured by means of a platinum electrode. The time series Eh data were extrapolated to infinite time using the method of Muller [1,2]. Results show no relationship between the analyzed ratios of Se(VI)/Se(IV) in solution and the observed Eh values at the platinum electrode. In contrast, acidic solutions of Fe^{3+}/Fe^{2+} show nearly perfect Nernstian behavior and rapid electron transfer at the platinum electrode. Based on the results of this study, it is probably invalid to use Eh measurements as input to any equilibrium computer model for purposes of predicting the behavior of a pure selenium system. 27 references, 4 figures, 1 table.

40642 **Geochemistry of natural technetium and plutonium.** Curtis, D.B.; Cappis, J.H.; Perrin, R.E.; Rokop, D.J. (Los Alamos National Lab., NM). pp 735-736 of Scientific basis for Nuclear Waste Management X. Bates, J.K.; Seefeldt, W.B. (eds.). Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—Pt.1).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

Technetium and plutonium in unprocessed nuclear reactor wastes are major concerns with regard to their containment in the geologic environment. Both nuclides have long half-lives; therefore, they will exist long after engineered barriers can be considered reliable. Consequently, strategies for the containment of these two elements depend on their retention in the geologic barrier until they have decayed to innocuous levels. Because these are the rarest elements in nature, there have been few direct observations of their geochemical behavior; predictions concerning their fate in the repository are based on properties that can be observed in the laboratory. The authors are attempting to complement the laboratory work by studying the geochemistry of natural plutonium and technetium. Ratios of anthropogenic to naturally occurring isotopes are discussed.

40643 **Zeolitization of glassy topopah spring tuff under hydrothermal conditions.** Knauss, K.G. (Lawrence Livermore National Lab., CA). pp 737-745 of Scientific basis for Nuclear Waste Management X. Bates, J.K.; Seefeldt, W.B. (eds.). Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—Pt.1).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

In support of the Nevada Nuclear Waste Storage Investigations Project experiments were conducted to study the effects of heat generated by a nuclear waste repository in densely welded, devitrified tuff on the underlying, compositionally-equivalent glassy tuff at Yucca Mtn. Solid wafers of glassy tuff were reacted with a dilute ground water for several months at 150°C and 250°C at 100 bars pressure in Dickson-type, gold-bag rocking autoclaves. The in-situ chemistry of the hydrothermal fluids was modeled and the chemical affinities for all possible mineral precipitation reactions (contained within the extensive database) were calculated using the EQ3/6 program. In the 250°C experiment the calculations suggest that a zeolite mineral would be expected to form. Analyses of the run products showed that not only had the wafer been extensively corroded and the glass shards replaced by clinoptilolite, but pure clinoptilolite had precipitated directly from solution. In the 150°C experiment, although clay minerals were thermodynamically favored to form in the first half of the experiment, by the end of the run a zeolite mineral was predicted to form. Analyses of the run products showed no well-formed secondary minerals (clays or zeolites) had formed. At the lower temperature the effects of precipitation kinetics may preclude the formation of the zeolite within the time span of this experiment. In general the observations are in relatively good agreement with the geochemical model calculations. This type of study demonstrates the interpretive/predictive capabilities of a combined experimental/geochemical modeling approach to studies of nuclear waste isolation. This combined approach will aid in satisfying licensing requirements to assure long-term performance. 7 references, 3 figures, 3 tables.

40644 **Humic colloid generation of transuranic elements in groundwater and their migration behavior.** Kim, J.I.; Buckau, G.; Zhuang, W. (Institut fuer Radiochemie, Garching, West Germany). pp 747-756 of Scientific basis for Nuclear Waste Management X. Bates, J.K.; Seefeldt, W.B. (eds.). Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—Pt.1).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

The generation of humic colloids of Am(III) has been investigated in Gorleben groundwaters containing different amounts of humic substances. Dissolved organic carbon (DOC) in these groundwaters consists mainly of humic acid and fulvic acid, which is present in a colloidal form through aggregation with trace heavy metal ions of groundwater constituents. Concentrations of these heavy metal ions are proportional to the DOC concentration. The

generation of Am(III) pseudocolloids through geochemical interactions with humic colloids in different groundwaters is quantified by ultrafiltration as well as ultracentrifugation by the aid of radiometric concentration measurements. The speciation of dissolved Am(III) species in groundwaters is carried out by laser induced photoacoustic spectroscopy (LPAS). 12 references, 8 figures, 4 tables.

40645 **Transport of radionuclides by concentrated brine in a porous medium with micropore-macropore structure.** Hassanizadeh, S.M. (National Institute for Public Health and Environmental Hygiene(RIVM), Leidschendam, Netherlands). pp 757-767 of Scientific basis for Nuclear Waste Management X. Bates, J.K.; Seefeldt, W.B. (eds.). Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—Pt.1).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

This work concerns itself with the study of effects of soil aggregation and high salt concentrations on the transport of radionuclides by concentrated brine flowing through an aggregated porous medium. The medium is considered to be composed of porous rock aggregates separated by macropores through which the brine flows and transport of salt and radionuclides takes place. The aggregates contain dead-end pores, cracks, and stationary pockets collectively called micropores. The micropore space does not contribute to the flow, but it serves as a storage for salt and radionuclides. Adsorption of radionuclides takes place at internal surfaces of aggregates where they assume that a linear equilibrium isotherm describes the process. A one-dimensional numerical model is developed which is based on two sets of equations: one set for the flow and transport of salt and another set for transport of radionuclides. Results of numerical experiments clearly indicate that the existence of high salt concentrations markedly reduces the peak of nuclides concentration and slows down their movement. Also, it is found that diffusive mass exchange between macropores and aggregates results in a pronounced lowering of the radionuclides concentration peaks. 9 references, 7 figures.

40646 **Radiometric dating of ochoan (permian) evaporites, WIPP site, Delaware basin, New Mexico, USA.** Brookins, D.G.; Lambert, S.J. (Univ. of New Mexico, Albuquerque). pp 771-780 of Scientific basis for Nuclear Waste Management X. Bates, J.K.; Seefeldt, W.B. (eds.). Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—Pt.1). Contract AC04-76DP00789.

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

The authors have attempted radiometric dating of halide-sulfate salts and clay minerals from the Delaware Basin, New Mexico, USA, as part of geochemical study of the stability of the evaporite sequence at the WIPP (Waste Isolation Pilot Plant - a US DOE facility) site. They undertook this dating to determine: (1) primary age of evaporite genesis or time(s) of recrystallization, (2) if previously undated evaporite minerals (leonite, polyhalite, kieserite) give useful data, and (3) if the detrital clay minerals have been radiometrically reset at any time following their incorporation into the evaporite medium. They have shown earlier that polyhalites can indeed be successfully dated by the K-Ar method, and once corrections are applied for admixed halide minerals, dates of 210-230 Ma for the Delaware Basin are obtained. Rb-Sr isochrons from early stage sylvites-polyhalites-anhydrites yield 220 +/- 10 Ma, even when some sylvites yield lower K-Ar dates due to loss of $^{40}Ar^{*}$. K-Ar dates on leonites and kieserites are also low due to $^{40}Ar^{*}$ loss, but their Rb-Sr dates are higher. Detrital clay minerals from the Delaware Basin collectively yield a highly scattered isochron (390 +/- 77 Ma), but samples from a local area, such as the WIPP Site, give a much better age of 428 +/- 7 Ma. These dates show that the interaction between the clay minerals and the evaporitic brines was insufficient to reset the clay minerals Rb-Sr systematics. In a related study, they note that a dike emplaced into the evaporite at 34 Ma had only very limited effect on the intruded rocks; contact phenomena were all within 2 m of the dike. All of their geochemical (radio-metric and trace element) studies of the WIPP site argue for preservation of the isotopic and chemical integrity of the major minerals for the past 200 Ma. 19 references, 1 figure, 5 tables.

40647 **Laboratory and modelling studies of sodium bentonite groundwater interaction.** Snellman, M.; Uotila, H.; Rantanen, J. (Technical Research Center of Finland, Espoo). pp 781-790 of Scientific basis for Nuclear Waste Management X. Bates, J.K.; Seefeldt, W.B. (eds.). Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—Pt.1).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

According to the present Finnish concept sodium bentonite will be used as a buffer material in the repository for high-level waste. Experimental and theoretical studies treating the effect of bentonite upon the chemical conditions in a repository have been initiated with the object of specifying the chemistry of the near field. Sodium bentonite was let react with water under anaerobic conditions at 25°C for 540 days, during which time six fluid samples were extracted for the chemical analysis of 15 chemical species. The generated fluid phase was alkaline (pH = 9...10) and contained a high amount of bicarbonate. Also a low redox-potential was measured. The fluid phase chemistry was investigated using the geochemical code PHREEQE. Calcite saturation was observed in all fluid samples. A modelling of sodium bentonite interaction with water based on the main mineral components of bentonite was also performed with PHREEQE. A fairly good agreement between experimental results and model calculations was observed. 12 references, 3 figures, 5 tables.

40648 **Permanent crystal lattice contraction, a primary mechanism in thermally induced alteration of Na bentonite.** Pusch, R. (Swedish Geological Co., Lund). pp 791-802 of Scientific basis for Nuclear Waste Management X. Bates, J.K.; Seefeldt, W.B. (eds.). Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—Pt.1).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

The basic process in thermal transformation of smectite to hydrous mica is generally thought to be a lattice charge change caused by partial replacement of tetrahedral silica by aluminum. This is assumed to yield preferential uptake of potassium with concomitant contraction and loss of expandability of smectite aggregates as well as release of silica that migrates by diffusion from interlayer space into interaggregate voids, where it may form amorphous silica hydrogels and possibly quartz. The latter process was investigated by use of hydrothermal tests of fully water saturated, as well as partly saturated Na-montmorillonite gels, the intention being to identify possible heat-induced changes in expandability on a molecular scale by applying electron microscopy. The gels were exposed to a temperature of 225°C for 18 days in a first test series and the microstructural patterns compared with those of non-heated material. A clear tendency of lattice contraction was observed in the heated clay gels, particularly in the non-saturated one. The microstructure had the form of networks of virtually non-expandable, interwoven dense stacks. A possible physical explanation of the contraction is that the heat caused instability of the interlayer water lattices, yielding dominant interatomic mass forces which caused contraction of the stacks. In connection herewith, silica was released from the smectite lattices and precipitated at the edges of the stacks, which reduced or eliminated the expandability. Minute, precipitated silicic bodies, amorphous as well as crystalline, appeared in both clays. 13 references, 9 figures.

40649 **Diffusion mechanisms of strontium and cesium in compacted sodium bentonite.** Muurinen, A.; Penttilae-Hiltunen, P.; Rantanen, J. (Technical Research Center of Finland, Espoo). pp 803-812 of Scientific basis for Nuclear Waste Management X. Bates, J.K.; Seefeldt, W.B. (eds.). Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—Pt.1).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

In this research the diffusion of strontium and cesium through bentonite slabs in stationary state has been measured. The measurement gives directly the transport through the sample and the corresponding effective diffusivity. The apparent diffusivity, diffusivity of the sorbed ions as well as the sorption factors can also be evaluated on the basis of the same diffusion measurement. The

sorption on the compacted bentonite has also been measured in a special sorption test where a radioactive tracer has been allowed to diffuse into compacted bentonite until equilibrium was reached. The measured effective diffusivities were clearly higher than they would be in the case of pure pore diffusion. The effective diffusivities also increase with K/sub D/ and the apparent diffusivities are almost independent on K/sub D/. This supports the theory that also the sorbed ions diffuse in their own phase. The sorption factors of the compacted bentonite correspond to the values of the batch experiments. 9 references, 7 figures, 2 tables.

40650 **Choice of french clays as engineered barrier components for waste disposal.** Coulon, H.; Lajudie, A.; Debrabant, P.; Atabek, R.; Jorda, M.; Andre-Jehan, R. (CNRS, Villeneuve d'Ascq, France). pp 813-824 of Scientific basis for Nuclear Waste Management X. Bates, J.K.; Seefeldt, W.B. (eds.). Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—Pt.1).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

Results are presented of physical measurements on candidate buffer materials for use in nuclear fuel waste disposal. The materials being considered as constituent elements of engineered barriers are essentially calcium smectite clays, in other terms swelling clays, coming from fourteen french deposits. The criteria for good candidates are mainly: smectite content in the clay materials, carbonate and organic material content and bulk density of the material, compacted under a pressure of 100 MPa. 14 references, 4 figures, 6 tables.

0540 Health And Safety

REFER ALSO TO CITATION(S) 40958, 41928, 41974

40651 **(INIS-XN—58) Assessment and recording of radiation doses to workers.** (Nuclear Energy Agency, 75 - Paris (France)). 1986. 28p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87702599.

Also published in French.

The assessment and recording of the radiation exposure of workers in activities involving radiation risks are required for demonstrating compliance with institutional dose limitations and for a number of other complementary purposes. A significant proportion of the labor force involved in radiation work is currently represented by those specialised workers who operate as itinerant contractors for different nuclear installations and in different countries. In order to ensure that the exposure of these workers is adequately and consistently controlled and kept within acceptable limits, there is a need for the criteria and methods for dose assessment and recording to be harmonised throughout the different countries. An attempt in that direction has been made in this report, which has been prepared by a group of experts convened by the Committee on Radiation Protection and Public Health of the OECD Nuclear Energy Agency. Its primary purpose is to describe recommended technical procedures for an unified approach to the assessment and recording of worker doses. The report is published under the responsibility of the Secretary-General of the OECD, and does not commit Member governments.

40652 **(JAERI-M—86-132) Health physics in JAERI, no.28. April 1, 1985 - March 31, 1986.** (Japan Atomic Energy Research Inst., Tokyo). Sep 1986. 264p. (In Japanese). NTIS (US Sales Only), PC A12/MF A01. File Number DE87702617.

In the annual report No.28 (fiscal 1985) are described the activities of health physics including radioactive waste management in Tokai Research Establishment, Takasaki Radiation Chemistry Research Establishment and Oarai Research Establishment. There were no occupational exposure exceeding the maximum permissible dose and no release of radioactive gaseous and liquid waste beyond the release limit specified according to the regulations. In the environment there were observed no abnormal radioactivity due to facilities. Technology development and research; Technology developments were made as in the previous years for improving the techniques and methods in monitoring of individuals, facilities and environment, radiation measurement instrumentation and also in waste management and decontamination. The following works were made in the researches of radiation dosimetry, body radioactivity, airborne radioactivity and estimation of radiation dose due to low level waste disposal. For radiation dosimetry: portable apparatus for calibration of radioactive gas monitors, evaluation of β-ray depth dose distribution, and exposure analysis through an extended series of specific jobs at JRR-2. For body radioactivity: characteristic of JAERI phantom for an assessment of Pu in lung, transfer compartment in the internal dose evaluation method, and radiosensitivity of chromosomes of rabbit lymphocytes. For airborne radioactivity and estimation of radiation dose due to wastedisposal: sheltering effect of houses for radioactive effluent, tritium oxide permeability of membrance in protective appliances, conversion rate of low concentration tritium gas to tritiated water, computer code for calculation of radiation dose from very low-level radioactive waste disposal and safety demonstration tests of national disposal of very low-level radioactive solid waste.

40653 **(NUREG—0837-Vol.7-No.1) NRC [Nuclear Regulatory Commission] TLD [thermoluminescent dosimeter] Direct Radiation Monitoring Network: Progress report, January-March 1987.** Jang, J.; McNamara, N.; Cohen, L. (Nuclear Regulatory Commission, King of Prussia, PA (USA). Region I). Jul 1987. 223p. NTIS, PC A10 - GPO. File Number DE87900919.

Ambient radiation levels result from naturally occurring radionuclides present in the soil, cosmic radiation constantly bombarding the earth from outer space, and the contribution, if any, from the monitored facilities and other man-made sources. The Network is intended to measure radiation levels during routine facility operations and to establish background radiation levels used to assess the radiological impact of an unusual condition, such as an accident. This report presents the radiation levels measured around all facilities in the Network for the first quarter of 1987. A complete listing of the site facilities monitored is included. In some instances, two power reactor facilities are monitored by the same set of dosimeters. All radiation measurements are made using small, passive detectors called thermoluminescent dosimeters (TLDs), which provide a quantitative measurement of the radiation levels in the area in which they are placed. Each site is monitored by arranging approximately 40 to 50 TLD stations in two concentric rings extending to about five miles from the facility. All TLD stations are outside the site boundary of the facility. A complete description of the program can be found in NUREG-0837, Volume 2, Number 4 and NUREG-0837, Volume 3, Number 4. The National Bureau of Standards (NBS) has performed an independent study of the following characteristics of the NRC dosimetry system; energy response, angular dependence, temperature and humidity sensitivity, fading, light dependence, self-irradiation, and reproducibility. NBS has also tested the response of the NRC's dosimetry system against the requirements of ANSI N545-1975 and NRC Regulatory Guide 4.13. Details of this testing can be found in NUREG/CR-2560, NUREG/CR-3120, and NUREG/CR-3775.

40654 (PNL—6100-Pt.1, pp 41-43) **Toxicity of thorium cycle nuclides.** Ballou, J.E. Feb 1987. NTIS, PC A06/MF A01. File Number DE87010024.

In Pacific Northwest Laboratory: annual report for 1986 to the DOE Office of Energy Research: Part 1, Biomedical Sciences.

The purpose of this project is to investigate the biological hazards associated with uranium-thorium breeder fuels and fuel recycle process solutions. Initial studies emphasize the metabolism and long-term biological effects, in rodents, of inhaled ^{233}U-^{232}U nitrate and of ^{231}Pa, a major, long-lived, radioactive waste product. This project, initiated in 1975, was terminated in FY 1986. 3 figures.

40655 **(PNL-SA—13791) A mobile laboratory: Emergency sample analyses at the accident site.** Wilson, R.H. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1986. Contract AC06-76RL01830. 8p. (CONF-860932—8). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012059.

From Radiological accidents, perspectives and emergency planning preparedness; Bethesda, MD, USA (15 Sep 1986).

The Pacific Northwest Laboratory (PNL) provides technical support to the Department of Energy (DOE) with rapid response

to the site of a radiological accident for initial assessment of radiological conditions in the surrounding environs. A mobile laboratory manned with a trained crew is capable of collecting, preparing, and analyzing air, liquid, vegetation, and soil samples from the areas surrounding the accident site. Rapid assessment of radiological conditions is important to enable responsible agencies to immediately administer appropriate response and coordinate any necessary longer-term management of the accident site. Sensitive instrumentation and support equipment provide the capability to rapidly assess environmental conditions for uncontrolled areas as stated in DOE Order 5480.1 Chapter XI. A regimen is required to maintain proficiency and to train new crew members. A professional team responding with a well-equiped mobile laboratory capable of providing quick analytical results has a positive impact on public relations. Confidence is also generated among other agencies with an awareness of the technical expertise that is available for assistance and backup in the event of a radiological accident. 2 refs., 2 tabs.

40656 **High-level waste package licensing considerations for extrapolating test data.** Johnson, T.C.; Chang, K.C.; Jungling, T.L.; Person, L.S.; Peterson, C.H.; Voglewede, J.C.; Wick, E.A. (Nuclear Regulatory Commission, Washington, DC). pp 3-13 of Scientific basis for Nuclear Waste Management X. Bates, J.K.; Seefeldt, W.B. (eds.). Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—Pt.1).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

Programs intended to provide supporting information for the high-level radioactive waste (HLW) repository program must consider the licensing requirements and the technical issues involved with extrapolation of short-term test data to periods of up to 10,000 years. The licensing requirements of the Nuclear Regulatory Commission (NRC), and the issues the NRC staff considers important for the development of predictive methods, are described. Because performance predictions of the geologic repository and particular components of the waste package must largely be based upon inference, a reasonable assurance, on the basis of the record before the Commission, is the general standard that will be required. 3 references, 2 figures.

40657 **Performance analysis of a repository for low and intermediate level reactor waste.** Vieno, T.; Nordman, H.; Vuori, S.; Peltonen, E. (Technical Research Center of Finland, Helsinki). pp 381-392 of Scientific basis for Nuclear Waste Management X. Bates, J.K.; Seefeldt, W.B. (eds.). Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—Pt.1).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

In Finland, utilities producing nuclear energy are responsible for the management of the radioactive waste, including final disposal. As regards low and intermediate level waste, the approach has been adopted to employ the power plant sites for locations of repositories. The repositories will be excavated at the depth of about 50 to 125 m in the bedrock of the two Finnish nuclear power plant sites, Loviisa and Olkiluoto. The performance analysis presented in this paper has been carried out for the Preliminary Safety Analysis Report (PSAR) of the Olkiluoto repository. A flexible model has been developed to estimate the release of radionuclides from waste packages and their subsequent transport through the engineered barriers in the repository. Gradual degradation of the engineered barriers is accounted for by altering parameters at fixed time points. Safety margins of the disposal concept have been evaluated by including disturbed evolution scenarios in the analysis. 13 references, 10 figures, 2 tables.

40658 **Cask ownership: Options and strategic factors.** Smith, C.W. pp 1-22 of The high level waste business, transportation, storage and disposal. Bethesda, MD; Atomic Industrial Forum (1986). (CONF-861032—).

From High level waste business: transportation, storage and disposal; Charleston, SC, USA (19 Oct 1986).

Because of the potential number of casks available through utility modular storage programs, it is imperative that the planning for the provision and operation of casks under the NWPA program include consideration of the utility owned casks. As to the remainder of the cask requirements for implementation of the NWPA, the author believes that the cost factor is an artificial one for determining the benefits to the taxpayers and ratepayers for cask ownership and that the decision should be made on the basis of capability of the industry to perform on a competitive bid basis and assurance that the shipments will be made on a timely, safe and cost effective basis. If the procurement process is structured to rally permit competitive bidding on spent fuel shipping services, the competition in the market place will assure that DOE and the ratepayers, receive safe, high quality, and cost effective transportation proposals from very capable companies.

40659 **Cask technology program activities.** Allen, G.C. Jr. (Sandia National Labs., Albuquerque, NM 87185). pp 1-9 of The high level waste business, transportation, storage and disposal. Bethesda, MD; Atomic Industrial Forum (1986). (CONF-861032—). Contract AC04-76DP00789.

From High level waste business: transportation, storage and disposal; Charleston, SC, USA (19 Oct 1986).

The civilian waste cask technology program consists of five major activities: Technical issue resolution directed toward NRC and DOT concerns; system concept evaluations to determine the benefits of proposals made to DOE for transportation improvements; applied technology and technical data tasks that provide independent information and enhance technology transfer between cask contractors; standards development and code benchmarking that provide a service to DOE and cask contractors; and testing to ensure the adequacy of cask designs. This paper addresses broad issues that affect several cask development contractors and areas where independent technical input could enhance OCRWM goals.

40660 **Leach resistance of iodine compounds in Portland cement.** Scheele, R.D.; Burger, L.L.; Wiemers, K.D. (Pacific Northwest Lab., Richland, WA 99352). pp 373-390 of Geochemical behavior of disposed radioactive waste. Barney, G.S.; Navratil, J.D.; Schulz, W.W. Washington, DC; American Chemical Society (1984). (CONF-830303—).

From 185. American Chemical Society national meeting; Seattle, WA, USA (20 Mar 1983).

Several radioactive iodine isotopes arise from the production of electricity by nuclear power. Most of these are short-lived with half-lives less than a few days and will have decayed to negligible levels by the time the spent nuclear fuel is reprocessed; however, / sup 129/I has a half life of 16 million years. The ultimate objective of any disposal form development project is to find an immobilization system which is prepared easily from the waste products of the recovery processes and will not allow hazardous material release during transport, interim storage, normal disposal, and in the event of a credible occurrence such as groundwater intrusion into the disposal repository. For /sup 129/I the time required for radioactive decay makes achievement of this goal very difficult. In the author's laboratory the authors have examined methods of iodine removal from gas streams, techniques for fixing the iodine in stable solid forms, and methods of disposal. One of the techniques which proved attractive was to incorporate an insoluble, stable iodine compound in a cement matrix. This paper describes the development and leach testing of this system using Portland III cement as the solidification matrix.

0550 Safeguards, Inspection, And Accountability

REFER ALSO TO CITATION(S) 40927

40661 **(DP-MS—87-48) Overview of an automated, near realtime materials accounting system in use at the Savannah River Plant.** Clark, W.C. Jr. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). 1987. Contract AC09-76SR00001. 5p. (CONF-870713—32). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012382.

From 28. INMM annual meeting on safeguards: a mature technology; Newport Beach, CA, USA (12 Jul 1987).

A reliable material accounting system is a requirement for the operation of any nuclear facility. At the Savannah River Plant, an automated, near realtime, accounting system has been developed to provide such reliability. The system's design provides timely detection of diversion or accounting problems by monitoring the ac-

tivity in 18 unit process areas (UPAs). Material balance calculations are performed for each UPA after a batch of material has completed a processing step. In most cases, an inventory difference (ID) for a UPA is established at least every 24 hours. Detection of an accounting problem is further enhanced by an online measurement control program. This program evaluates the performance of most measurement equipment every 12 hours. Error estimates are propagated when a material balance is closed to provide a realtime limit of error for the inventory difference. To minimize false alarms, the data must be reliable and free of input errors. Solution volumes, container identifications, material weights, etc., are all collected via direct computer connections. Manual data input is used only as a backup to the automated system. Automatic data collection also provides a quick and easy method of entering accounting data. Data entry is therefore performed simultaneously with production operations, without reducing throughput. Finally, requests for analytical results required to determine nuclear material concentrations are made online. Concentrations are determined using one of ten assay devices or by analysis performed in a dedicated laboratory. When results are available, the information is posted on the accounting computer and any required adjustments are performed automatically. If necessary, material balances are reclosed to reflect the ID changes caused by a posted results.

40662 **(EUR—8020-Pt.3) Integral experiment relating to calibration and interpretation of plutonium solid waste measurements at Dounreay nuclear power development establishment. Part 3: Destructive analysis of high α, β, γ and high α, low β, γ waste streams.** Bremner, W.B.; Burgoyne, K.; Spence, B.W.; Birkhoff, G. (Commission of the European Communities, Ispra (Italy). Joint Research Centre; Commission of the European Communities, Luxembourg). 1986. 48p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87752284.

The measurement of plutonium in solid wastes which arise from PFR fuel reprocessing has been achieved by the use of non-destructive analysis (NDA) techniques at selected points on the various waste routes. These systems are calibrated by using both synthetic standards, which closely approximate the waste streams in matrix composition and plutonium content, and by mathematical modelling which uses a classical theoretical approach. This report represents collaborative work carried out by UKAEA Dounreay, Joint Research Centre Ispra and Lyon University France which relates to the characterisation and sampling of two selected solid waste streams in the PFR fuel reprocessing operation at DNPDE. This paper, gives details of the sampling procedures, historical data and destructive analysis techniques which were applied to high α, β, γ (leached hulls) and high α low β γ waste streams arising from PFR fuel reprocessing. The work was carried out after two PFR fuel reprocessing campaigns had been completed thus providing adequate statistical data. The levels of plutonium, which were found in these streams was much lower than had been anticipated at the plant design stage. This required some modification of the destructive analysis approach. These procedures must be repeated at intervals in order to establish a meaningful statistical pattern. If necessity the frequency of these checks must recognise the cost of such an approach and the interruption to the reprocessing operation.

40663 **(IAEA-INFCIRC—342) Text of the Agreement of 30 September 1986 concerning the Agency's assistance to Thailand for the transfer of enriched uranium from the United States for a research reactor.** (International Atomic Energy Agency, Vienna (Austria)). Mar 1987. 11p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702730.

The document reproduces the text of the Project and Supply Agreement concluded on 30 September 1986 between the Agency and the Government of the Kingdom of Thailand and the United States of America for the transfer of enriched uranium (approximately 49.0 kilograms of uranium enriched to approximately 19.90 per cent by weight in the isotope uranium-235) for a research reactor (TRIGA Mark III) in Thailand. 1 table.

40664 (IAEA-TECDOC—382, pp 201-208) **Negotiation and implementation of Safeguards.** Rainer, R. (International Atomic Energy Agency, Vienna, Austria. Legal Div.). Oct 1986. (In Spanish). NTIS (US Sales Only), PC A16/MF A01. File Number DE87702732. (CONF-8410472—).

From Regional course on legislation and regulation of nuclear safety for Latin American countries; Montevideo, Uruguay (15 Oct 1984).

The problems facing the negotiation and implementation of IAEA Safeguards are outlined. Some considerations relate to national and international activities, and the achievements of safeguards activities are highlighted.

40665 **(K/CSD/INF—87-13) Nuclear Materials Management and Safeguards System.** Baird, P.W.; Jacobsen, S.E.; Pedigo, R.B.; Matthews, W.B. III. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 1987. Contract AC05-84OT21400. 7p. (CONF-870713—38). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012680.

From 28. INMM annual meeting on safeguards: a mature technology; Newport Beach, CA, USA (12 Jul 1987).

This paper describes the Nuclear Materials Management and Safeguards System (NMMSS) which is sponsored by the Department of Energy and the Nuclear Regulatory Commission. The system serves national security and program management interests, and international interests in the programs for the peaceful application of nuclear energy and non-proliferation of nuclear weapons. Within the scope of the NMMSS are found all nuclear materials applied and controlled under United States law and related international agreements, including US nuclear materials production programs and US private nuclear industrial activities. In addition, its national and international scope enables it to provide services to other organizations such as the Arms Control and Disarmament Agency, the Department of State, and the US Congress.

40666 **(LA-UR—87-2295) Inventory differences: An evaluation methodology.** Heinberg, C.L.; Roberts, N.J. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 6p. (CONF-870713—35). NTIS, PC A02. File Number DE87013146.

From 28. INMM annual meeting on safeguards: a mature technology; Newport Beach, CA, USA (12 Jul 1987).

This paper discusses an evaluation methodology which is used for inventory differences at the Los Alamos National Laboratory. It is recognized that there are various methods which can be, and are being, used to evaluate process inventory differences at DOE facilities. The purpose of this paper is to share our thoughts on the subject and our techniques with those who are responsible for the evaluation of inventory differences at their facility. One of the most dangerous aspects of any evaluation technique, especially one as complex as most inventory difference evaluations tend to be, is to fail to look at the tools being used as indicators. There is a tendency to look at the results of an evaluation by one technique as an absolute. At the Los Alamos National Laboratory, several tools are used and the final evaluation is based on a combination of the observed results of a many-faceted evaluation. The tools used and some examples are presented.

40667 **(LA-UR—87-2349) Where do the Nuclear Materials Management functions fit in the Materials Control and Accountability (MC and A) plan?.** DeVer, E.A. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 7p. (CONF-870713—37). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013155.

From 28. INMM annual meeting on safeguards: a mature technology; Newport Beach, CA, USA (12 Jul 1987).

Safeguards had its beginning in the early 1940s and has continued to grow through the stormy years in dealing with nuclear materials. MC & A Plans have been developed for each facility which includes requirements for containment, surveillance, internal controls, measurements, statistics, records and report systems, and inventory certification of its nuclear materials, in the context of how precisely the inventory is known at stated risk or confidence levels. The I & E Regulations, the newest document affecting the control system, are used for testing the current MC & A plan in place at each facility. Nuclear Materials Management activities also

have reporting requirements that include: (1) Annual Forecast, (2) Materials Management Plan, (3) Quarterly Status Report, (4) Assessment Report, and (5) Scrap and Excess Material Management. Data used to generate reports for both functions come from the same data base and source documents at most facilities. The separation of sponsoring groups at the DOE for NM Accountability and NM Management can and does pose problems for contractors. In this paper, we will try to separate and identify these overlaps at the Facility and DOE level.

40668 **(ORNL/Sub—87-37733/1) Analysis for preliminary evaluation of discrete fracture flow and large-scale permeability in sedimentary rocks.** Kanehiro, B.Y.; Lai, C.H.; Stow, S.H. (Oak Ridge National Lab., TN (USA)). May 1987. Contract AC05-84OR21400. 64p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87013356.

Conceptual models for sedimentary rock settings that could be used in future evaluation and suitability studies are being examined through the DOE Repository Technology Program. One area of concern for the hydrologic aspects of these models is discrete fracture flow analysis as related to the estimation of the size of the representative elementary volume, evaluation of the appropriateness of continuum assumptions and estimation of the large-scale permeabilities of sedimentary rocks. A basis for preliminary analysis of flow in fracture systems of the types that might be expected to occur in low permeability sedimentary rocks is presented. The approach used involves numerical modeling of discrete fracture flow for the configuration of a large-scale hydrologic field test directed at estimation of the size of the representative elementary volume and large-scale permeability. Analysis of fracture data on the basis of this configuration is expected to provide a preliminary indication of the scale at which continuum assumptions can be made.

40669 **(UCRL—15890) Survey procedure: Control and accountability of nuclear materials.** Van Ness, H. (Lawrence Livermore National Lab., CA (USA)). Feb 1987. Contract W-7405-ENG-48. 21p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87012907.

This procedure outlines the method by which the Department of Energy (DOE) San Francisco Operations Office (SAN) will plan and execute periodic field surveys of the Material Control and Accountability (MC and A) program and practices at designated contractors' facilities. The surveys will be conducted in accordance with DOE Order 5630.7, Control and Accountability of Nuclear Materials Surveys (7/8/81) to ascertain compliance with applicable DOE Orders and SAN Management Directives in the 5630 series, as well as the adequacy of the contractor's program and procedures. Surveys will be conducted by the Safeguards and Security Division of DOE-SAN. The survey team will review and evaluate the adequacy of the contractor's procedures and practices for nuclear material control and accounting by means of physical inventory, internal control, measurement and statistics, material control indicators, records and reports, and personnel training. The survey will include an audit of records and reports, observation of inventory procedures, an independent test of the inventory and a review and evaluation of the inventory differences, accidental losses, and normal operational losses as applicable to the facility to be surveyed.

0560 Legislation And Regulations

REFER ALSO TO CITATION(S) 40501, 40583, 40600, 40656, 40658

40670 **(IAEA-INFCIRC—343) Text of the Agreement establishing the Asian Regional Co-operative Project on Medical and Biological Applications of Nuclear Techniques.** (International Atomic Energy Agency, Vienna (Austria)). Apr 1987. 5p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702562.

The full text of the Agreement establishing the Asian Regional Co-operative Project on Medical and Biological Applications of Nuclear Techniques between the Agency and member states is reproduced. The Agreement entered into force on 20 May 1986 after the governments of Japan, Bangladesh and the Philippines had notified the Agency of their acceptance of the Agreement.

40671 (IAEA-TECDOC—382, pp 209-215) **Legal aspects of the international transport of radioactive materials.** Havinh Phuong. (International Atomic Energy Agency, Vienna, Austria. Legal Div.). Oct 1986. (In Spanish). NTIS (US Sales Only), PC A16/MF A01. File Number DE87702732. (CONF-8410472—).

From Regional course on legislation and regulation of nuclear safety for Latin American countries; Montevideo, Uruguay (15 Oct 1984).

The paper deals with safety requirements for international transport of radioactive materials as laid down in the IAEA regulations. Liability for nuclear damage during transport is also discussed. Harmonization of nuclear shipments through existing international regulations is emphasized. 11 refs.

40672 (IAEA-TECDOC—382, pp 217-221) **Physical protection for the transport of nuclear material - A legal framework for safety.** Havinh Phuong. (International Atomic Energy Agency, Vienna, Austria. Legal Div.). Oct 1986. (In Spanish). NTIS (US Sales Only), PC A16/MF A01. File Number DE87702732. (CONF-8410472—).

From Regional course on legislation and regulation of nuclear safety for Latin American countries; Montevideo, Uruguay (15 Oct 1984).

The main international documents on the physical protection of nuclear material during transport are presented. The basic principles and requirements are outlined as well as the current status of the Convention on the Physical Protection of Nuclear Material.

40673 (IAEA-TECDOC—382, pp 187-199) **Basic provisions of IAEA Safeguards Agreements.** Rainer, R. (International Atomic Energy Agency, Vienna, Austria. Legal Div.). Oct 1986. (In Spanish). NTIS (US Sales Only), PC A16/MF A01. File Number DE87702732. (CONF-8410472—).

From Regional course on legislation and regulation of nuclear safety for Latin American countries; Montevideo, Uruguay (15 Oct 1984).

The paper examines the legal issues involved in IAEA Safeguards Agreements and deals with: 1) the technical elements in such agreements; 2) General aspects of safeguards; 3) administrative practice; 4) privileges and immunities of safeguards inspectors; and 5) sanctions and protection of safeguards related information.

07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY

0701 Physical Isotope Separation

REFER ALSO TO CITATION(S) 40682

40674 (INIS-mf—10916, pp 1142) **Medical applications of the MGC cyclotron in Debrecen.** Ando, L.; Fenyvesi, A.; Mahunka, Imre; Szelecsenyi, F.; Tarkanyi, F.; Molnar, T. (Orvostudomanyi Egyetem, Debrecen, Hungary). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

From 14. international cancer congress; Budapest, Hungary (21 Aug 1986).

40675 **(K/ITP—131) Multicomponent isotope separation in matched abundance ratio cascades composed of stages with large separation factors.** Von Halle, E. (Oak Ridge Gaseous Diffusion Plant, TN (USA). International Technology Programs). Jun 1987. Contract AC05-84OT21400. 35p. (CONF-870782—1). NTIS, PC A03/MF A01; GPO Dep. File Number DE87011702.

From Workshop on separation phenomena in liquids and gases; Darmstadt, F.R. Germany (20 Jul 1987).

The concept of the matched abundance ratio cascade and the system of equations for performing multicomponent productivity calculations upon them has proven extremely useful for analyzing the behavior of gaseous diffusion plants in which the stage separation factors are very nearly equal to unity. Recent interest in the

gas centrifuge process, in which the separation factor of a single centrifuge can be relatively large, makes desirable the extension of the theory of the matched abundance ratio cascade to cascades composed of stages with large separation factors. Equations permit the calculation of the productivity for simple cascades composed of stages with large separation factors. The concentration gradient of each of the isotopic species present can be calculated and the cascade description can be determined. An illustrative example dealing with the separation of the isotopes of tungsten in a cascade composed of gas centrifuges is included.

40676 (ZfI—64, pp 19) **KRYPKAS - calculation of steady-state concentration profiles for isotopic polynary mixtures in thermal diffusion cascades with both ends closed.** Engel, S.; Mueller, G. Dec 1986. NTIS (US Sales Only), PC A03/MF A01. File Number DE87702867.

In Computer codes for problems of isotope and radiation research.

0702 Radiation Sources

REFER ALSO TO CITATION(S) 40787, 41868, 42251, 42252

40677 **(JAERI-M—86-157) Improvement of efficiency and dose uniformity of irradiation by separation of Co-60 sources.** Hoshi, T. (Japan Atomic Energy Research Inst., Tokyo). Nov 1986. 38p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. File Number DE87702637.

It was explained with examples that both of efficiency and uniformity of irradiation is improved by puting interval between the two source elements. The optimum value of the source interval was derived for improvement of irradiation performance of cylindrical type irradiator with line sources of Co-60 located at the center and conveyor type irradiator with plane source of Co-60.

40678 (ZfI—64, pp 13) **MIKROB, MIKRO3, MIKRA3, MIKROT - programs for the numerical computation of electronic trajectories in a microtron.** Schmidt, H. Dec 1986. NTIS (US Sales Only), PC A03/MF A01. File Number DE87702867.

In Computer codes for problems of isotope and radiation research.

40679 (ZfI—64, pp 14) **POTVER, HPIONBA - simulation of ion beams for an electrode ion extraction system.** Nickel, A. Dec 1986. NTIS (US Sales Only), PC A03/MF A01. File Number DE87702867.

In Computer codes for problems of isotope and radiation research.

0703 Isotopic Power Supplies

40680 **(DPST—86-133-4/87-3) ^{238}Pu fuel form activities.** (Savannah River Lab., Aiken, SC (USA)). Jun 1987. Contract AC09-76SR00001. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013284.

This report for ^{238}Pu Fuel Form Activities has one main section: SRP-PuFF Facility. The SRL portion of this program has been completed. The program status, budget information, and milestone schedules are discussed. The SRP portion of this report summarizes production of $^{238}PuO_2$ fuel forms for use in radioisotopic thermoelectric generators (RTG's) in the Plutonium Fuel Form (Puff) Facility at the Savannah River Plant. The PuFF Facility has been placed in a production readiness mode of operation pending funding of additional heat source programs.

08 HYDROGEN

0801 Production

40681 **(EUR—9934) Study and development of heat resisting diaphragms for electrolysis. Final report.** Dick, R.; Faye, P. (Commission of the European Communities, Luxembourg). 1985. 101p. (In French). NTIS (US Sales Only), PC A06/MF A01. File Number DE87752553.

Two types of diaphragms for alkaline water electrolyzers have been prepared. Their porosity, mechanical properties and electrical conductivity have been studied for several preparation techniques with the aim of finding the preparation conditions leading to a low ohmic resistance of the diaphragm. The first diaphragm type has been prepared using inorganic oxides and hydroxides, bonded with PTFE and sintered at 360/sup 0/C. The second diaphragm type the bonding agent was polysulphone. Endurance tests have been performed in an electrolytic cell at 160/sup 0/C in 40% KOH solution for the PTFE bonded diaphragm. For diaphragms bonded with polysulphone, testing was done at 110/sup 0/C in 30% KOH.

40682 **Solid H/sub 2//D/sub 2/ gas generators.** Artz, G.D.; Grant, L.R. (to Secretary of the Army, Washington, DC). US Patent 4,673,528. 16 Jun 1987. Filed date 30 Sep 1985. vp.

This patent describes a thermally stable, solid reactant hydrogen and deuterium gas generator compositions comprising in weight percentages as follows: an oxidizer compound selected from the group of oxidizer compounds: LiNO/sub 3/ and KNO/sub 3/ from about 59 to about 15; binder of polytetrafluorethylene from about 2 to about 15; and magnesium borohydride diammoniate in an amount from about 80 to about 90 as a source of hydrogen gas or the equivalent weight of the deuterated analog of the magnesium borohydride diammoniate is a source of deuterium gas.

0808 Properties

40683 **Ignition by excimer laser photolysis of ozone.** Lucas, D.; Dunn-Rankin, D.; Hom, K.; Brown, N.J. Northridge, CA; Combustion Institute (1986). 32p. (CONF-8610180—). Combustion Institute, Western States Sect., c/o L.S. Caretto, Calif. State Univ., Northridge, CA 91330. Contract AC03-76SF00098.

From Fall meeting of the Western States Section/Combustion Institute; Tucson, AZ, USA (27 Oct 1986).

Technical Paper WSS/CI LBL-20871.

The authors have ignited mixtures of hydrogen, oxygen, and ozone in closed cells with 248 nm radiation from a KrF excimer laser. Ozone, the only significant absorber in this system, absorbs a single photon and produces oxygen atoms which initiate combustion. A discretized, time-dependent Beer's law model is used to demonstrate that the radical concentration immediately after photolysis is a function of laser power, ozone concentration, focal length, and separation between the lens and reaction cell. Spark schlieren photographs are used to visualize the ignition events and identify the ignition sites. The effects of equivalence ratio, pressure, and the initial gas temperature on the minimum ozone concentration needed to produce ignition are presented, and only the initial temperature has a significant effect. Modelling studies of the igniton process aid in the interpretation of the experimental results, and show that the ignition is not due solely to thermal effects, but is strongly dependent on the number and type of radicals present initially after photolysis. Ignition using other hydrocarbons as fuels was also demonstrated.

09 OTHER SYNTHETIC AND NATURAL FUELS

REFER ALSO TO CITATION(S) 41113, 41573

0901 Hydrocarbon Fuels

REFER ALSO TO CITATION(S) 40429

40684 (UCRL—96374) Surface studies of UFe_2 and evaluation of its catalytic properties with a $2H_2$:CO mixture. Schultz, J.; Naegele, J.; Spirlet, J.C.; Colmenares, C. (Lawrence Livermore National Lab., CA (USA); Commission of the European Communities, Karlsruhe (Germany, F.R.). European Inst. for Transuranium Elements). 24 Mar 1987. Contract W-7405-ENG-48. 9p. (CONF-870443—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012903.

From 2. international conference on the basic and applied chemistry of f-transition and related elements; Lisbon, Portugal (6 Apr 1987).

The reactivity of UFe_2 with O_2, CO and CO_2 were studied using x-ray photoelectron spectroscopy (XPS). Adsorption of O_2 on clean UFe_2 surfaces (Fe/U $\cong$ 2.0), produced by argon-ion sputtering, leads to the formation of UO_2 and depletion of Fe from the surface layer probed by XPS (Fe/U $\cong$ 0.8). The oxidation state of Fe in this layer, as determined by XPS (Fe 2p/sub 3/2/ = 710.4 eV), is between Fe^{+2} and Fe^{+3} of pure Fe oxides. Exposure of sputtered-clean UFe_2 to CO and CO_2 results in a slight broadening of the U 4f peaks, indicating U oxidation, and some Fe depletion in the analyzed layer (Fe/U $\cong$ 1.7). The O ls (530.2 and 530.4 eV for CO and CO_2, respectively) and C ls (282.7 and 282.6 eV for CO and CO_2, respectively) indicate that dissociative chemisorption to O and C atoms occurs. UFe_2 ground into a fine powder was tested as a catalyst in a differential high-pressure flow reactor with a $2H_2$:CO gas mixture. A significant amount of methanol and hydrocarbons are produced at 577K; while hydrocarbons are the main products (>99%) at 739K. XPS analysis of the used catalyst indicates that U is present as UO/sub 2+x/ and Fe as Fe_2O_3.

40685 Alkaline cleavage of model lignin compounds. Nelson, D.A.; Samuels, W.D.; Hallen, R.T. (Pacific Northwest Lab., Richland, WA). *Energy and Fuels;* **1**: No. 3, 239-242(May-Jun 1987).

The alkaline cleavage of lignin models 2a-h, based upon 2-phenoxy-1-phenyl-1-propanol with electron-donating and -withdrawing groups on the phenoxy ring, proceeds through an internal displacement of the aryloxy group to provide an epoxide intermediate that opens to the glycol. The epoxide (2-methyl-3-phenyloxirane) was observed only after the alkaline cleavage of 2h, 2-(4-nitrophenoxy)-1-phenylpropanol, since the observed rate of disappearance of the epoxide is faster than that of all the lignin models except 2h. The observed rate of reaction was found to be sensitive to steric bulk and polar substituents in the ortho position of the aryloxy ring. Another product, 1-phenyl-2-propanone, is present in the product mixture, which suggests the occurrence of a concurrent pyrolysis mechanism. 13 refs., 1 fig., 1 tab.

0902 Alcohol Fuels

REFER ALSO TO CITATION(S) 40703, 40704, 40705

40686 (LBL—22151, pp 1.31-1.33) Separations by reversible chemical association. King, C.J.; Kertes, A.S.; Arenson, D.; Tamada, J.; Rixey, W. Mar 1987. NTIS, PC A02/MF A01. File Number DE87009270. Contract AC03-76SF00098.

In Energy Conversion and Storage Program: FY 1986, Annual report.

Separations of polar organic substances from aqueous solution consume a large amount of energy industrially. Examples include recovery of ethanol, butanol, acetic acid, glycols, phenols, adipic acid, sugars, and corn-starch products. Needs for recovering such substances will increase still further and become more complex with the advent of bioprocessing technology, since most of the methods for production of chemical from biomass generate products in dilute aqueous solution. The initial phases of the project have included literature surveys of the extraction chemistry of carboxylic acids and alcohols and measurement and chemical modeling of phase-equilibrium behavior for extraction of carboxylic acids by amine extractants in various diluents, and for extraction of alcohols by phenolic extractants in various diluents. Another part of the project concerns use of non-functionalized, and, therefore, non-wetting, solid polymeric adsorbents for recovery and fractionation of carboxylic acids, alcohols and glycols from aqueous solution. Non-wetting adsorbents have air-filled pores, which reduce concomitant uptake of water and provide uptake that is rate-limited by vapor-phase diffusion along the pores. Solutes can thereby be fractionated according to volatility over aqueous solutions, and solutes of surprisingly low volatility can be adsorbed because of the very short transport paths.

40687 (SERI/STR—231-3180) Degradation of lignocellulosic biomass and its subsequent utilization for the production of liquid fuels: Subcontract progress report, 1 March 1982-31 August 1982. Cooney, C.L.; Demain, A.L.; Sinskey, A.J.; Wang, D.I.C. (Solar Energy Research Inst., Golden, CO (USA)). Jul 1987. Contract AC02-83CH10093. 153p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE87012262.

This project is a coordinated effort to develop process technology for the degradation of lignocellulosic biomass and its utilization for the production of liquid fuels. Current efforts are based on our prior success in developing a single-step microbiological process for the conversion of lignocellulose to ethanol. This process utilizes a mixed culture of Clostridium thermocellum, a thermophilic cellulolytic anaerobe which degrades cellulose and hemicellulose to fermentable sugars, and Clostridium thermosaccharolyticum, a thermophilic anaerobic which produces high concentrations of ethanol from both hexoses and pentoses. The proposed studies will focus on the use of C. thermocellum and its cellulases for enhanced saccharification of lignocellulose and on the direct fermentation of lignocellulose to the liquid fuel, butanol. Efforts on saccharification are directed to facilitate the adoption of existing fermentation ethanol plants for cellulosic substrates and to overcome the rate limiting step of saccharification in the mixed culture. The effort on butanol will extend the concept of direct fermentation to the production of this liquid fuel.

40688 (SERI/STR—231-3183) Degradation of cellulosic biomass and its subsequent utilization for the production of chemical feedstocks: Subcontract progress report, 1 September 1980-28 February 1981. Wang, D.I.C.; Cooney, C.L.; Demain, A.L.; Gomez, R.F.; Sinskey, A.J. (Massachusetts Inst. of Tech., Cambridge (USA); Solar Energy Research Inst., Golden, CO (USA)). Jul 1987. Contract AC02-83CH10093. 234p. NTIS, PC A11. File Number DE87012266.

This is a coordinated program to effect the microbiological degradation of cellulosic biomasses and will focus on the use of anaerobic microorganisms which possess cellulolytic enzymes. These studies will attempt to increase the enzyme levels through genetics, mutation and strain selection. In addition, the direct conversion from cellulosic biomasses to liquid fuel (ethanol) and/or soluble sugars by the cellulolytic, anaerobic organism is also within the scope of this program. Process and engineering scale-up, along with economic analyses, will be performed throughout the course of the program. The second area of our major effort is devoted to the production of chemical feedstocks. In particular, three fermentations have been identified for exploration. These are acrylic acid, acetone/butanol and acetic acid. The main efforts in these fermentations will address means for the reduction of the cost of manufacturing for these large volume chemicals.

40689 **(SERI/STR—231-3184) Degradation of cellulosic biomass and its subsequent utilization for the production of chemical feedstocks: Subcontract progress report, 1 September 1979-29 February 1980.** Wang, D.I.C.; Cooney, C.L.; Demain, A.L.; Gomez, R.F.; Sinskey, A.J. (Massachusetts Inst. of Tech., Cambridge (USA); Solar Energy Research Inst., Golden, CO (USA)). Jul 1987. Contract AC02-83CH10093. 272p. NTIS, PC A12/MF A01; 1; GPO Dep. File Number DE87012265.

This is a coordinated program to effect the microbiological degradation of cellulosic biomasses and will focus on the use of anaerobic microorganisms which posses cellulolytic enzymes. These studies will attempt to increase the enzyme levels through genetics, mutation and strain selection. In addition, the direct conversion from cellulosic biomasses to liquid fuel (ethanol) and/or soluble sugars by the cellulolytic, anaerobic organism is also within the scope of this program. Process and engineering scale-up along with economic analyses, will be performed throughout the cause of the program. The second area of our major effort is devoted to the production of chemical feedstocks. In particular, three fermentations have been identified for exploration. These are: acrylic acid, acetone/butanol and acetic acid. The main efforts in these fermentations will address means for the reduction of the cost of manufacturing for these large volume chemicals.

40690 **(SERI/TP—231-3194) Ethanol from lignocellulose; An overview.** Wright, J.D. (Solar Energy Research Inst., Golden, CO (USA)). Jul 1987. Contract AC02-83CH10093. 18p. (CONF-870822—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87001199.

From American Institute of Chemical Engineers summer national meeting; Minneapolis, MN, USA (16 Aug 1987).

Ethanol, a liquid fuel compatible with today's transportation system, can be produced by biological processes from lignocellulosic feedstocks. Biomass in an attractive feedstock for ethanol production because it is available in large quantities at low cost. Biological processes are very efficient, but each fraction of the lignocellulosic feedstock must be processed separately. Cellulose (a crystalline polymer of glucose), the structural core, comprises 40% of the feedstock. It is difficult to hydrolyze (break down) into glucose, but once formed, the glucose is readily fermented to ethanol. Cellulose can be hydrolyzed with either acid or enzymatic catalysts. Using acids, the chief problem is that conditions severe enough to promote hydrolysis also degrade the glucose, resulting in low (55%-80%) yields. Enzymatic processes are potentially much more efficient because enzymes catalyze only the hydrolysis reaction. However, these processes are much newer and less developed. Research is required to develop methods to make lignocellulose more digestible, to produce more active enzymes at lower cost, and to develop methods of hydrolysis where enzyme action is not inhibited by reaction end products. Approximately 30% of the feedstock is hemicellulose, which is largely made of xylan (a polymer of xylose). Xylan is easily hydrolyzed, but it is difficult to ferment to ethanol. Several potential methods of fermentation have been identified, but it is not yet clear which is the most promising. Lignin, the final major component, is a phenolic polymer that cannot be fermented to ethanol. However, it can be broken down to phenolic monomers, hydrotreated, and reacted with methanol to produce methyl aryl ethers, a high-octane gasoline additive. 21 refs., 11 figs., 1 tab.

13 Environmental Aspects

REFER ALSO TO CITATION(S) 40943

14 SOLAR ENERGY

40691 **(LA—10763-SR) Los Alamos optical materials reliability, maintainability, and exposure testing program status report.** Moore, S.W. (Los Alamos National Lab., NM (USA)). Jul 1987. Contract W-7405-ENG-36. 43p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87012703.

Cost effectiveness of many solar materials is a major factor in bringing solar products into widespread use. This factor is affected by initial cost as well as by durability. The object of this program is to determine the least costly material that will do a specific job and to determine its lifetime such that the full life-cycle costing can be determined by the manufacturer. To this end, material operating limitations, durabilities, and failure modes are being determined. This status report is an update of two previous reports that describe the basic program and the extended exposure results.

1401 Resources And Availability

40692 **(SERI/TR—215-2921) Extraterrestrial spectral solar irradiance data for modeling spectral solar irradiance at the earth's surface.** Riordan, C. (Solar Energy Research Inst., Golden, CO (USA)). May 1987. Contract AC02-83CH10093. 41p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87001179.

This report describes the extraterrestrial (air mass zero, AMO) spectral solar irradiance data used by the Solar Energy Research Institute's Resource Assessment Branch in models to calculate spectral solar irradiance at the earth's surface. The report contains tables and graphs of the AMO spectrum updated by the World Radiation Center in Daveos, Switzerland, in 1985.

40693 **(SERI/TR—215-3038) Investigation of a cloud-cover modification to SPCTRAL2, SERI's simple model for cloudless-sky, spectral solar irradiance.** Bird, R.E.; Riordan, C.J.; Myers, D.R. (Solar Energy Research Inst., Golden, CO (USA)). Jun 1987. Contract AC02-83CH10093. 37p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87001177.

This report summarizes the investigation of a cloud-cover modification to SPCTRAL2, SERI's simple model for cloudless-sky, spectral solar irradiance. Our approach was to develop a modifier that relies on commonly acquired meteorological and broadband-irradiance data rather than detailed cloud properties that are generally not available. The method was to normalize modeled, cloudless-sky spectral irradiance to a measured broadband-irradiance value under cloudy skies, and then to compare the normalized, modeled data with measured spectral-irradiance data to empirically derive spectral modifiers that improve the agreement between modeled and measured data. Results indicate the possible form of the spectral corrections; however, we must analyze additional data to develop a spectral transmission function for cloudy-sky conditions.

1403 Economics

REFER ALSO TO CITATION(S) 40720

1405 Solar Energy Conversion

REFER ALSO TO CITATION(S) 40685, 40687, 40688, 40689, 40690, 41374, 41403, 42044, 42178

40694 **(CONF-8704179—1) Plant sciences and biofuels production.** Ranney, J.W.; Cushman, J.H. (Oak Ridge National Lab., TN (USA)). Apr 1987. Contract AC05-84OR21400. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011656.

From 2. Pacific Basin biofuel workshop; Kauai, HI, USA (22 Apr 1987).

Integrating the production of lignocellulosic energy crops with conversion into efficient biofuel pathways requires the identification and prioritization of plant qualities that affect the conversion processes. When desirable or undesirable characteristics have been identified, potential crop species must be evaluated to determine how much genetic improvement is possible while maintaining a thriving fast-growing plant. Lignin, as an example, can be important in both thermochemical and biochemical conversion systems. Lignin's chemical composition is complex and varies among species. Lignin is energetically expensive for plants to produce, and it plays an important role in plant viability. To improve biomass feedstocks, lignin may be desired in increased or decreased amounts depending on the fuel pathway involved. Changes in chemical composition may also be desirable. The lignin component of biomass

feedstocks can be significantly affected, both in amount and in chemical composition, by species selection. Changing lignin content or chemical composition of a species is possible but will be more difficult, more expensive, and may affect plant growth and survival. Other biomass components are similar. Such considerations will strongly affect the choice and efficiency of breeding and bioengineering strategies. The selection of traits for improvement in energy crops is an important decision which must be made by plant scientists and investigators developing conversion technologies working as a team. 5 figs.

40695 **(DOE/ER/13575—1) [Guard cell biochemistry: Response to environmental stimuli causing changes in gas exchange]: Progress report and introduction to experimental rationale and methodology.** (Florida State Univ., Tallahassee (USA)). [1987]. Contract FG05-86ER13575. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013193.

Procedures are described for microbiochemistry of individual guard cells. Specifically, studies are described for the determination of phosphoenolpyruvate carboxylase (PEPC) in single cells, electrophoresis of the protein complement of small number of cells, the cellular location of abscisic acid, measurement of the photosynthetically driven electron transport in guard cells, and the role of malate in regulation of PEPC. 19 figs., 1 tab. (DT)

40696 **(EUR—9944) Implementation of low cost semicrystalline silicon solar cells process and characterization of solar grade polysilicon.** Ricaud, A. (Commission of the European Communities, Luxembourg). 1985. 53p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87752536.

The aim of the research is a deep survey of all parameters related to the manufacturing process of polycristalline photovoltaic solar cells in order to maximize the photovoltaic efficiency at a minimum cost. The background is the process of monocrystalline solar cells. The investigations have included the following items: 1) Study of the correlation between polycristalline defects and photovoltaic performances 2) Wafering and sawing damages according to various slicing machines. 3) Chemical 4) Diffusion processes. 5) Front metallization with electroless nickel plating. 6) Handling and mechanical stability. 7) Hot spot effect. 8) Overall photovoltaic efficiency in production. 9) Economic effect. 10) Characterization of solar grade polysilicon. The main results achieved are: By adding all the improvements investigated within the frame of this contract, the photovoltaic efficiency of polycrystalline solar cells can be improve from 9% to 10%. The chemical forecast is that the polycrystalline cell with supersede the single crystalline cell around the year 1983. By using a specially clean furnace and pure reactants it is possible to get a solar grade silicon from which we can produce solar cells showing a 4.5% photovoltaic efficiency. It is a promising achievement for such a preliminary experiment.

40697 (INIS-mf—10917, pp 44) **IBr photodissociation lasers as a simulation for a solar pumped system.** Shapiro, M.; Yogev, A. (Weizmann Inst. of Science, Rehovoth, Israel. Dept. of Chemical Physics and Structural Chemistry; Weizmann Inst. of Science, Rehovoth, Israel. Dept. of Isotopes). 1986. NTIS (US Sales Only), PC A07/MF A01. File Number DE87780153. (CONF-860919—Absts.).

From 6. international symposium on gas flow and chemical lasers; Jerusalem, Israel (8 Sep 1986).

40698 (LBL—22151, pp 1.12-1.14) **Solar energy conversion using microstructured materials: direct radiant heating of small particle suspensions.** Hunt, A.J.; Miller, F.; Noring, J.E.; Worth, D. Mar 1987. NTIS, PC A02/MF A01. File Number DE87009270. Contract AC03-76SF00098.

In Energy Conversion and Storage Program: FY 1986, Annual report.

The use of advanced materials for the collection and control of solar energy is being studied. Research is reported in four areas: (1) direct radiant heating of small-particle suspensions to produce useful fuels and chemicals, (2) radiant processing of gas-particle suspensions to initiate thermochemical storage reactions, (3) development of microporous transparent materials for insulating windows, and (4) the use of sol-gel techniques to produce advanced materials. Research results in the first area are discussed.

40699 **(PB—87-181442/XAB) Semiconductor photosensitization with an organometallic. Final report.** Walsh, F. (Tracer Technologies, Inc., Newton, MA (USA)). Aug 1984. 32p. NTIS, PC A03/MF A01.

The specific objectives of the Phase I research program were to prepare and test photocathodes with tetraazaannulenes (TAAs) as photosensitizers, to compare the performance of various TAAs in this application, and to demonstrate that a multi-electrode solar cell with TAA-sensitized photocathodes is technically feasible. The photoresponse of n-type SnO_2-coated cathodes when covered with a thin layer of a TAA was evaluated. Cell-performance data were obtained in an acidic Fe(+2)/Fe(+3) electrolyte. A direct relationship between cell performance and the first oxidation of half-wave potential of the TAAs tested was identified. The TAA was shown to be a p-type semiconductor capable of being the sole photoactive specie on a cathode in such stacked-electrode cells with an unoptimized power level of 5 uw/sq. cm.

40700 **(SAND—87-0147C) Development of an array tracking controller using a single chip computer.** Maish, A.B. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 9p. (CONF-870987—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010495.

From IEEE international workshop on control systems in new energy applications; Madrid, Spain (28 Sep 1987).

This paper reviews the design and performance analysis of a reliable, low-cost ($150) photovoltaic array sun tracking controller which is under development at Sandia National Laboratories. The system uses a Motorola single-chip computer to perform all tracking functions, and reliable, low-cost Hall-effect sensors to count motor turns. The EEPROM memory on the computer chip and a clock/calendar chip with battery backup are used to make the system recoverable from power failures. An important feature of the system is its ability to operate autonomously, independent of a master controller and without requiring operator alignment. The paper discusses the details of the self-alignment procedure which uses periodic measurements of the array current to determine the array tilt and clock errors.

40701 **(SERI/PR—212-3140) Solid State Photovoltaic Research Branch: Annual report, FY 1986.** (Solar Energy Research Inst., Golden, CO (USA)). Jun 1987. Contract AC02-83CH10093. 212p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE87001163.

This report summarizes the progress of the Solid State Photovoltaic Research Branch of the Solar Energy Research Institute (SERI) from 1 October 1985 through 30 September 1986. Five technical sections of the report cover these main areas of SERI's in-house photovoltaic research: Semiconductor Crystal Growth, Amorphous Silicon Research, Polycrystalline Thin Films, III-V High-Efficiency Photovoltaic Cells, and Solid State Theory. A short sixth section covers some of the work done under the PV Renowned Scientist Program at SERI. The task in each case was to explain the purposes and major accomplishments of the work in the context of the US Department of Energy's National Photovoltaic Program's research plans.

40702 **(SERI/STR—211-3033) A high-efficiency, single-junction, back-surface GaAs concentrator solar cell: Annual subcontract report, 1 February 1985-30 April 1986.** Lamorte, M.F. (Research Triangle Inst., Research Triangle Park, NC (USA); Solar Energy Research Inst., Golden, CO (USA)). May 1987. Contract AC02-83CH10093. 95p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87001178.

The goals of Phase I of this research program were to determine the performance potential and technological feasibility of the Al/sub x/Ga/sub 1-x/As-GaAs back-surface, point-contact concentrator solar cell. The scope of the work required that the goals would be achieved by applying an analytical model, a corresponding computer simulation, and thorough preliminary material growth and cell fabrication. The computer simulation provided realistic, quantitative projections of cell performance. Epitaxial growth and device fabrication demonstrated the technological feasibility of the structure and identified key issues to be resolved in Phase II. Computer modeling results are presented. An optimized cell design and

performance characteristics of similar cell designs were investigated. The optimum value of each parameter was obtained by allowing only that parameter to vary over a selected range and then determining the value at maximum efficiency. Simulation results showed that 30% efficiency may be obtained under operational conditions of 10^3 solar concentration and 300°K.

40703 **(SERI/STR—231-3158) Modeling of aspen wood hydrolysis in concentrated slurries: Final subcontract report.** Mutharasan, R.; Luu, D.V.; Teng, K.F. (Drexel Univ., Philadelphia, PA (USA); Solar Energy Research Inst., Golden, CO (USA)). Jun 1987. Contract AC02-83CH10093. 113p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87001193.

Hydrolysis of aspen wood in concentrated slurries (25 to 33% w/v) and dilute sulfuric acid (0.3 to 2.4N) at various temperature (150 to 240°C) have been conducted. Acid adsorption isotherm in the temperature range of 25 to 100°C is determined. A kinetic model, which accounts for the experimentally observed variation in bulk acid concentration and oligosaccharide intermediate formation, has been formulated and the various kinetic parameters in the model are calculated using conventional numerical approaches. In estimating the parameters, care has been exercised in data analysis so that the degree of freedom associated with the estimation is zero. Reasonable agreement is found between the model and the experimental data. The important contributions of this study are: (1) experimental characterization of oligomer formation in concentrated slurry systems, (2) characterization of acid adsorption by aspen wood, and (3) the development of a heterogeneous kinetic model for hydrolysis. 17 refs., 35 figs., 3 tabs.

40704 **(SERI/STR—231-3179) Degradation of lignocellulosic biomass and its subsequent utilization for the production of liquid fuels: Subcontract progress report, 1 September 1982-28 February 1983.** Cooney, C.L.; Demain, A.L.; Sinskey, A.J.; Wang, D.I.C. (Solar Energy Research Inst., Golden, CO (USA)). Jul 1987. Contract AC02-83CH10093. 159p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE87001200.

This project is a coordinated effort to develop process technology for the degradation of lignocellulosic biomass and its utilization for the production of liquid fuels. Current efforts are based on our prior success in developing a single-step microbiological process for the conversion of lignocellulose to ethanol. This process utilizes a mixed culture of Clostridium thermocellum, a thermophilic cellulolytic anaerobe which degrades cellulose and hemicellulose to fermentable sugars, and Clostridium thermosaccharolyticum, a thermophilic anaerobe which produces high concentrations of ethanol from both hexoses and pentoses. The proposed studies will focus on the use of C. thermocellum and its cellulases for enhanced saccharification of lignocellulose and on the direct fermentation of lignocellulose to the liquid fuel, butanol. Efforts on saccharification are directed to facilitate the adoption of existing fermentation ethanol plants for cellulosic substrates and to overcome the rate limiting step of saccharification in the mixed culture. The effort on butanol will extend the concept of direct fermentation to the production of this liquid fuel.

40705 **(SERI/STR—231-3181) Degradation of lignocellulosic biomass and its subsequent utilization for the production of liquid fuels: Subcontract progress report, 1 September 1981-28 February 1982.** Cooney, C.L.; Demain, A.L.; Sinskey, A.J.; Wang, D.I.C. (Solar Energy Research Inst., Golden, CO (USA)). Jul 1987. Contract AC02-83CH10093. 174p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE87012263.

This project is a coordinated effort to develop process technology for the degradation of lignocellulosic biomass and its utilization for the production of liquid fuels. Current efforts are based on our prior success in developing a single-step microbiological process for the conversion of lignocellulose to ethanol. This process utilizes a mixed culture of Clostridium thermocellum, a thermophilic cellulolytic anaerobe which degrades cellulose and hemicellulose to fermentable sugars, and Clostridium thermosaccharolyticum, a thermophilic anaerobe which produces high concentrations of ethanol from both hexoses and pentoses. The proposed studies will focus on the use of C. thermocellum and its cellulases for enhanced saccharification of lignocellulose and on the direct fermentation of lignocellulose to the liquid fuel, butanol. Efforts on saccharification are directed to facilitate the adoption of existing fermentation ethanol plants for cellulosic substrates and to overcome the rate limiting step of saccharification in the mixed culture. The effort on butanol will extend the concept of direct fermentation to the production of this liquid fuel.

40706 **Solar cell coverslide extraction apparatus.** Valley, C.R. (to Secretary of the Air Force, Washington, DC). US Patent 4,675,067. 23 Jun 1987. Filed date 17 Oct 1985. vp.

This patent describes an apparatus for extracting a coverslide from a solar cell in a solar cell module. The coverslide is adhered to the solar cell by a dissolvable layer of adhesive along a predetermined plane of attachment. The apparatus comprises: (a) a receptacle having a cavity defined therein; (b) a rack disposed in the cavity of the receptacle; (c) laterally spaced, generally vertical partitions mounted in the rack in side-by-side relationship. The partitions defining chambers open at their opposite ends and adapted to receive one or more solar cell modules; (d) retaining means for supporting solar cell modules in a leaning upright standing positions within the chambers with the plane of attachment of the coverslide to the solar cell in each module extending generally between the opposite ends of the respective chambers. The coverslides are free to completely detach from the solar cells; (e) a liquid solvent filling the cavity to above the level of solar cell modules received in the chambers. The solvent dissolves the adhesive attaching the coverslide to the solar cell in each module; and (f) means for flowing the solvent within the cavity along respective paths upwardly through some of the chambers and downwardly through other of the chambers.

40707 **Some aspects of pyrolysis oils characterization by high performance size exclusion chromatography.** Johnson, D.K.; Chum, H.L. (Chemical Conversion Research Branch, Solar Energy Research Institute, 1617 Cole Blvd., Golden, CO 80401). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **32**: No. 2, 167-177(Apr 1987). (CONF-870410—).

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

The utilization of biomass pyrolysis oils or isolated fractions of these feedstocks requires a fast overall characterization technique. Gas chromatographic techniques typically analyze only the volatile fraction (5%-50%) of underivatized oils. With proper choice of solvent and detector systems, the HPSEC on polystyrene-divinylbenzene copolymer gels of the whole oils can provide valuable information on the apparent molecular weight distributions and changes that occur upon aging or chemical fractionation. Several pyrolysis oils have been analyzed as well as fractions isolated by solvent elution chromatography. In order to understand better the observed low-molecular-weight region, a number of model substances of the main classes of compounds found in pyrolysis oils have been investigated.

40708 **Formation of aromatic compounds from carbohydrates. X reaction of xylose, glucose, and glucuronic acid in acidic solution at 300°C.** Theander, O.; Nelson, D.A.; Hallen, R.T. (Dept. of Chemistry and Molecular Biology, Swedish Univ. of Agricultural Sciences, S-75007 Uppsala). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **32**: No. 2, 143-147(Apr 1987). (CONF-870410—).

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

For several years our respective groups have investigated the formation of aromatic compounds from carbohydrates in aqueous solution at various pH-values under reflux or hydrothermolytic conditions. For instance, previous papers in this series concerned the degradation of hexoses, pentoses, erythrose, dihydroxyacetone, and hexuronic acids to phenolic and enolic components. Of particular interest were the isolation and identification of catechols, an acetophenone, and chromones from pentoses and hexuronic acids at pH 4.5. The formation of these compounds, as well as reductic acid, was found to be more pronounced than that of 2-furaldehyde

under acidic conditions. The aromatic precursors of 3 and 4 were also isolated from these reaction mixtures. This is in contrast to the high yields of 2 obtained from pentoses and hexuronic acids at very low pH.

40709 **Biomass liquefaction utilizing extruder-feeder reactor system.** White, D.H.; Wolf, D.; Zhao, Y. (Dept. of Chemical Engineering, Univ. of Arizona, Tucson, AZ). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **32**: No. 2, 106-116(Apr 1987). (CONF-870410—).

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

Biomass including wood could provide liquid fuels on a regional basis if an economic liquefaction process can be developed. Through research sponsored by the U.S. Department of Energy (DOE), under its Thermochemical Conversion Program managed by Battelle PNL, the University of Arizona has developed a unique method of pumping concentrated, viscous biomass slurries, characteristic in biomass direct liquefaction systems. A modified single-screw extruder has now been shown to be capable of pumping solid slurries as high as 60 wt.% wood flour in wood oil derived vacuum bottoms.

40710 **Production and characterization of pyrolysis liquids from municipal solid waste.** Helt, J.E.; Agrawal, R.K. (Argonne National Lab., 9700 S. Cass Ave., Argonne, IL 60439). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **32**: No. 2, 82-89(Apr 1987). (CONF-870410—). Contract W-31-109-ENG-38.

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

Municipal solid waste (MSW) is a highly variable "raw material," by both season and location. Cellulosic materials, including paper, newsprint, packaging materials, wood wastes, and yard clippings, constitute over 50% of MSW. A basic understanding of the pyrolytic reactions is important and relevant to both combustion and conversion of MSW. As MSW is heated the different components react differently at different temperatures. The volatile species can evaporate without major change, and the rest of the cellulosic components partially break down to volatile components leaving a carbonaceous char that contains the ash and noncombustibles. The volatile pyrolysis products consist of a gaseous fraction containing CO, CO/sub 2/, some hydrocarbons, and H/sub 2/, which are noncondensables. There is a condensable fraction containing H/sub 2/O, volatile hydrocarbons and low molecular weight degradation products such as aldehydes, acids, ketones, and alcohols.

40711 **Heat flux requirements for fast pyrolysis and a new method for generating biomass vapor.** Reed, T.B.; Cowdery, C.D. (Colorado School of Mines, Golden, CO 80401). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **32**: No. 2, 68-81(Apr 1987). (CONF-870410—).

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

The term "fast pyrolysis" has been used to describe a pyrolysis regime in which vapor production is enhanced and char minimized by rapid heating. It has been found in the last decade that high yields of primary pyrolysis oil can be achieved using fast pyrolysis. More recently it has been found that the pyrolysis vapors can be converted to high grade fuels using a catalyst. This makes fast pyrolysis of biomass desirable for synthetic fuel manufacture. The authors present results derived from the Diebold Integrated Kinetic Model (DKM) that predict the time, the temperature, and the products of pyrolysis and the heat for pyrolysis of cellulose as a function of heating rates between 0.01 and 10/sup 5/°C/min. This range covers very slow pyrolysis requiring days to fast pyrolysis occurring in fractions of a second. The predictions are in good qualitative agreement with experimental measurements. They then compare the heat flux required for slow and fast pyrolysis for particles with that which can be obtained with practical heating devices. The comparison shows that convective and radiative heat transfer is adequate for fast pyrolysis of small particles, but not for large particles, due to conduction to the interior.

40712 **Production of primary pyrolysis oils in a vortex reactor.** Diebold, J.; Scahill, J. (Chemical Conversion Research Branch, Solar Energy Research Institute, 1617 Cole Blvd., Golden, CO 80401). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **32**: No. 2, 21-28(Apr 1987). (CONF-870410—).

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

A vortex tube has certain advantages as a chemical reactor, especially if the reactions are endothermic, the reaction pathways are temperature dependent, and the products are temperature sensitive. With low temperature differences, the vortex reactor can transmit enormous heat fluxes to a process stream containing entrained solids. This reactor has nearly plug flow and is ideally suited for the production of pyrolysis oils from biomass at low pressures and residence times to produce about 10 wt % char, 13% water, 7% gas, and 70% oxygenated primary oil vapors based on mass balances. This product distribution was verified by carbon, hydrogen, and oxygen elemental balances. The oil production appears to form by fragmenting all of the major constituents of the biomass.

40713 **Biomass to gasoline (BTG): Upgrading pyrolysis vapors to aromatic gasoline with zeolite catalysis at atmospheric pressure.** Diebold, J.; Scahill, J. (Chemical Conversion Research Branch, Solar Energy Research Institute, 1617 Cole Blvd., Golden, CO 80401). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **32**: No. 2, 297-307(Apr 1987). (CONF-870410—).

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

The primary pyrolysis vapors generated by the fast pyrolysis of biomass at atmospheric pressures consist initially of low-molecular-weight compounds, but which polymerize readily upon condensation. Prior to condensation, these primary vapors have been found to be very reactive with ZSM-5 catalyst to produce methyl benzenes boiling in the gasoline range. This gasoline is predicted to have very high blending octant numbers. By-products are coke, carbon oxides, water, naphthalenes, ethylene, propylene, and some phenols. The effect of different by-products on the theoretical gasoline yield is examined.

40714 **Molecular-beam, mass-spectrometric studies of wood vapor and model compounds over HZSM-5 catalyst.** Evans, R.J.; Milne, T.A. (Chemical Conversion Research Branch, Solar Energy Research Institute, 1617 Cole Blvd., Golden, CO 80401). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **32**: No. 2, 287-296(Apr 1987). (CONF-870410—).

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

Following research and development successes in the gasification of biomass the biomass component of DOE's Biofuels and Municipal Waste Technology Division program is emphasizing direct liquefaction processes to premium hydrocarbon fuels. The approach being explored at SERI involves an integrated, ambient-pressure process in which primary wood pyrolysis vapor is formed by fast pyrolysis and immediately passed over a shape-selective catalyst to remove oxygen as H/sub 2/O, CO, and CO/sub 2/. The authors report preliminary screening results on the behavior of wood pyrolysis vapor and model compounds when passed, at high dilution, over a sample of HZSM-5 supplied by the Mobil Corporation.

40715 **Catalytic hydrodeoxygenation and dealkylation of a lignin model compound.** Ratcliff, M.; Posey, F.; Chum, H.L. (Chemical Conversion Research Branch, Solar Energy Research Institute, 1617 Cole Blvd., Golden, CO 80401). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry;* **32**: No. 2, 249-256(Apr 1987). (CONF-870410—).

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

A comparison is presented of the hydrotreatment of 4-propylguaiacol (4PG) exploring two catalysts: MoS/sub 2/ on γ-alumina and the dual functionality MoS/sub 2//NiS on phosphated γ-

alumina at 250°-450°C and 500 psig of hydrogen. The catalyst with acidic support was found to promote substantial dealkylation of 4PG into a number of alkylated phenols such as methyl- (predominantly meta- and para-), ethyl-, and methylpropyl-phenols. The main reaction product on the less acidic catalyst was 4-propylphenol. At 350°C, mild deoxygenation to phenols can be maximized, whereas higher temperatures favor the formation of hydrocarbons, aromatic and saturated. Higher space velocities also favor mild deoxygenation to phenols.

40716 (SAND—86-1514-Vol.11-No.-1, pp 46-55) **Harnessing the sun: solar energy programs.** Apr 1987. NTIS, PC A04/MF A01. File Number DE87009977.

In Sandia technology: Volume 11, No. 1.

Advanced research being conducted at Sandia is an important factor in the rapid progress of solar and wind technologies. Although solar-produced power is not economically competitive on US utility grids, technological advances (assuming continued funding) are expected to reduce costs significantly within a decade, making these alternate energy sources important contributors to increased electric power demands beyond the 1990s. Four principal technologies for converting sunlight into electricity are: central receiver thermal conversion, distributed receiver thermal conversion, photovoltaics, and wind power. Research programs in each of these areas that deal with the production of either electricity or high-temperature thermal energy are discussed.

40717 **Solar simulators and I-V measurement methods.** Emery, K.A. (Solar Energy Research Institute, Golden, CO). *Solar Cells;* **18**: No. 3/4, 251-260(Sep-Oct 1986). (CONF-8506237—).

From Photovoltaics and insolation measurements workshop; Vail, CO, USA (30 Jun 1985).

The illuminated current versus voltage (I-V) characteristics of a photovoltaic (PV) device typically measured with respect to standard reference conditions, are defined by a spectrum, intensity, temperature, and area. Factors that influence I-V measurements include voltage sweep rate and direction, contact to the metallization, light source, junction temperature, instrumentation, and intensity. The merits and problems of various procedures influencing the repeatability and accuracy of I-V data are discussed.

1406 Photovoltaic Power Systems

40718 **(EPRI-AP—5229) Hesperia photovoltaic power plant: 1985 performance assessment: Final report.** Stokes, K.W. (New Mexico Solar Energy Inst., Las Cruces (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jul 1987. 57p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920523.

Operation of the Hesperia photovoltaic power plant, owned and operated by ARCO Solar, Inc., is reviewed in this report. Since December 1982, the plant has been providing power to Southern California Edison Company's distribution system. The 1985 performance assessment presented here is based on the review of performance data from the on-site data acquisition system and site operation and maintenance data, provided by ARCO Solar, Inc. The primary results are: For operating conditions measured at 1000 W/m² and 20°C ambient, the plant is rated at 728.2 kW dc and is 7.2% efficient. In 1985 more than 2244 MWh dc were produced at an average energy efficiency of 6.2%. The Hesperia plant produced about 96% of its energy potential during 1985. Almost all of the energy losses were caused by high winds and resultant tracker problems. The routine operation and maintenance of the system was estimated at less than .20 hours per MWh ac generated, which is equivalent to $.005 per kWh ac, if maintenance costs are $25 per hour. The Hesperia photovoltaic power plant was a reliable energy producer during 1985.

40719 **(SAND—87-1123C) The issue of harmonic injection from utility integrated photovoltaics systems: Part 1, The harmonic source.** Stevens, J. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 5p. (CONF-870757—4). NTIS, PC A02. File Number DE87011633.

From IEEE Power Engineering Society summer meeting; San Francisco, CA, USA (12 Jul 1987).

Harmonic injection is a growing concern to electric utility companies. One potential source of harmonics is utility intertied photovoltaic (PV) systems. This paper investigates the role of the PV system as a harmonic injector and discusses the various aspects of PV power converter design which impact harmonic injection. Small, residential-sized units, if greatly proliferated, are the greatest source of concern to utilities, as larger systems are typically designed to the interconnected utility's specification. Techniques are available to limit the harmonic output of these smaller units without resorting to bulky, expensive filtering.

1407 Solar Thermal Power Systems

REFER ALSO TO CITATION(S) 40716, 40724, 40729

40720 **Economic evaluation of solar thermal energy systems using a levelized energy cost approach.** Williams, T.A.; Dirks, J.A. (Pacific Northwest Lab., Richland, WA 99352). pp 95-106 of Alternative energy sources VII. Veziroglu, T.N. New York, NY; Hemisphere Publishing (1985). (CONF-851201—). Contract AC06-76RL01830.

From 7. Miami international conference on alternative energy sources; Miami Beach, FL, USA (9 Dec 1985).

In this paper a Levelized Energy Cost (LEC) approach to economic evaluations of solar thermal power plants is discussed. Levelized Energy Costs are life cycle costs that include a plant's capital cost, total operation and maintenance cost, taxes, interest, and return on investment. A LEC approach provides an economically correct treatment of these costs and allows an evaluation of alternative solar thermal power systems. In this paper, general economic principals relating to LEC calculations such as the time value of money, discount rate, net present value, and annualized cost are defined and explained. The use of LEC analyses in choosing between alternatives is discussed. The method of calculating an LEC for a solar thermal plant presented in this paper has recently been used within the U.S. Department of Energy in the development of technology goals for solar thermal systems. A general approach to LEC calculations that is applicable to all energy systems is described. Then the simplified approach for calculating an LEC using the standard economic assumptions for solar thermal applications is presented. Finally, a way to easily carry out the LEC calculation on a microcomputer is given.

40721 **Long-term technology goals for solar thermal energy systems.** Williams, T.A. (Pacific Northwest Lab., Richland, WA 99352). pp 179-190 of Managing nuclear operations. Veziroglu, T.N. New York, NY; Hemisphere Publishing (1985). (CONF-851201—). Contract AC06-76RL01830.

From 7. Miami international conference on alternative energy sources; Miami Beach, FL, USA (9 Dec 1985).

This paper describes long term performance and cost goals developed for the solar thermal technology. These goals were developed in support of the U.S. Department of Energy's (DOE) solar thermal technology program, and are intended to aid in planning research activities needed to make solar thermal energy an option which is both technically and economically attractive. Technology goals were developed for the middle to late 1990s time frame, and encompass both system level goals and component goals. System goals are energy price targets which must be met for solar thermal to be economically viable in a given market. Component goals are performed and cost targets for the primary elements of a solar thermal plant (concentrators, receivers, etc.) which would allow achievement of the system level goal. Component goals were developed based on considerations of improvements in component efficiency and cost which could be attained though further R&D. System goals are developed for electricity and Industrial Process Heat (IPH) applications. Both of these applications represent areas where solar thermal could potentially displace a large quantity of conventional energy sources. Component goals are developed for three solar thermal technologies: central receivers, parabolic dishes, and parabolic troughs. The central receiver and para-

bolic dish technology are expected to be used for both electricity and IPH applications.

1409 Solar Thermal Utilization

REFER ALSO TO CITATION(S) 40727, 41139

40722 (DOE/CE/30742—17) A case study of two passive solar commercial buildings: Volume 1, Johnson Controls, Inc. at Salt Lake City, Utah and comparison with building at Wells, Minnesota: Final report. (ESG, Inc., Atlanta, GA (USA). Energy Systems Group). Aug 1984. Contract AC02-82CE30742. 143p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87013396.

In this study, "calibrated" simulation models were developed for two small commercial buildings with energy conserving features including passive solar elements and daylighting. BLAST version 3.0 was used with the input files adjusted so that good agreement was obtained between predictions and actual measurements from on-site monitoring and data recording. The calibrated models were evolved by first obtaining a good match between predicted and measured temperature profiles and then examining the thermal loads to confirm performance. A limited number of parametric runs were made using a range of typical climate conditions to determine how the buildings might be expected to perform in other locations and to gain insight into this technique for evaluation. During this process, comparison was made with a baseline building configured to represent more conventional construction practices. It was found that both buildings performed well when compared to the baseline building, particularly during the heating season. It is concluded that the calibrated model technique is a very useful method for evaluation of a building design which might be replicated in several locations, and that it should be useful in comparing different design features. Volume 1 is primarily concerned with the Johnson Controls Building at Salt Lake City, Utah. It also includes presentation of climate sensitivity data from both the Johnson Controls Building and the Security State Bank Building at Wells, Minnesota.

40723 (DOE/CE/30742—18) A case study of two passive solar commercial buildings: Volume 2, Security State Bank Building at Wells, Minnesota: Final report. (ESG, Inc., Atlanta, GA (USA). Energy Systems Group). Aug 1984. Contract AC02-82CE30742. 146p. NTIS, PC A07. File Number DE87013397.

In this study, "calibrated" simulation models were developed for two small commercial buildings with energy conserving features including passive solar elements and daylighting. BLAST version 3.0 was used with the input files adjusted so that good agreement was obtained between predictions and actual measurements from on-site monitoring and data recording. The calibrated models were evolved by first obtaining a good match between predicted and measured temperature profiles and then examining the thermal loads to confirm performance. A limited number of parametric runs were made using a range of typical climate conditions to determine how the buildings might be expected to perform in other locations and to gain insight into this technique for evaluation. During this process, comparison was made with a baseline building configured to represent more conventional construction practices. It was found that both buildings performed well when compared to the baseline building, particularly during the heating season. It is concluded that the calibrated model technique is a very useful method for evaluation of a building design which might be replicated in several locations, and that it should be useful in comparing different design features.

40724 (SAND—85-2319-Rev.) Foster Wheeler Solar Development Corporation Modular Industrial Solar Retrofit qualification test results. Cameron, C.P.; Dudley, V.E.; Lewandowski, A.A. (Sandia National Labs., Albuquerque, NM (USA); EG and G Washington Analytical Services, Inc., Albuquerque, NM (USA); Solar Energy Research Inst., Golden, CO (USA)). Apr 1987. Contract AC04-76DP00789. 76p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87012517.

Under the Department of Energy's Modular Industrial Solar Retrofit project, industrial process steam systems incorporating line-focus solar thermal collectors were designed and hardware was installed and tested. This report describes the test results for the system designed by Foster Wheeler Solar Development Corporation. The test series included function and safety tests to determine that the system operated as specified, an unattended operations test to demonstrate automatic operation, performance tests to provide a database for predicting system performance, and life cycle tests to evaluate component and maintenance requirements. Component-level modifications to improve system performance and reliability were also evaluated.

40725 (SAND—85-2320-Rev.) Solar Kinetics, Incorporated, Modular Industrial Solar Retrofit qualification test results. Cameron, C.P.; Dudley, V.E. (Sandia National Labs., Albuquerque, NM (USA); EG and G Washington Analytical Services, Inc., Albuquerque, NM (USA)). Apr 1987. Contract AC04-76DP00789. 85p. NTIS, PC A04/MF A01; GPO Dep. File Number DE87012516.

Under the Department of Energy's Modular Industrial Solar Retrofit project, industrial process steam systems incorporating line-focus solar thermal collectors were designed and hardware was installed and tested. This report describes the test results for the system designed by Solar Kinetics, Incorporated. The test series included function and safety tests to determine that the system operated as specified, an unattended operations test to demonstrate automatic operation, performance tests to provide a database for predicting system performance, and life cycle tests to evaluate component and maintenance requirements. Component-level modifications to improve system performance and reliability were also evaluated.

40726 Evaluating the performance of energy conservation products what are the issues. Biemer, J.R.; Auburg, C.D. (Bonneville Power Administration). pp 9.11-9.13 of Proceedings from the ACEEE 1986 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1986). (CONF-860818—).

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

Bonneville Power Administration (BPA) has studied the performance of a variety of energy conservation products including: water heaters, solar water heating systems, refrigerators, electric motors, heat pump water heaters, and windows. The authors have observed that a number of important issues are common across the whole spectrum of products.

1410 Solar Collectors And Concentrators

REFER ALSO TO CITATION(S) 40725

40727 Advanced optical materials for energy efficiency and solar conversion. Lampert, C.M. (Lawrence Berkeley Lab., CA, USA). *Solar and Wind Technology;* **4**: No. 3, 347-379(1987).

Materials science properties of optical materials and coatings are discussed for a broad range of solar conversion, architectural glazings and greenhouse energy efficient uses. Transparent low emittance coatings for glazings are discussed for radiative heat transfer reduction. Both interference multilayer and doped semiconductor low emittance coatings are covered. The use of Drude theory to model coatings is discussed. Discussion of various types of selective absorbers include interference multilayer, composite tandem absorbers and selective paints. Effective medium theories are used to describe composite absorbers. The basic properties of radiative cooling materials and antireflection coatings are detailed. Also, the properties of reflector materials on glass and plastics are covered. Application of fluorescent concentrators, spectral splitting and cold mirror films are outlined. Research on transparent aerogel insulation and optical switching films for windows are introduced.

1420 Heat Storage

40728 **(ETEC—87-5) Storage tank heat losses through thermosiphoning in two SFBP [the Solar in Federal Buildings Program] solar systems.** Francetic, J.S.; Robinson, K.S. (Rockwell International Corp., Canoga Park, CA (USA). Energy Technology Engineering Center). Jul 1987. Contract AC03-76SF00700. 50p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013694.

Comprehensive monitoring and performance analyses of Solar in Federal Buildings Program (SFBP) quality sites indicated that storage tank heat losses were significantly higher than design estimates. In some cases, measured losses were as much as 10 times the calculated losses. One potentially significant source of heat loss in solar systems is thermosiphoning. A series of tests was conducted at two SFBP quality solar systems to investigate the existence and magnitude of thermosiphon losses from storage subsystems.

40729 (LBL—22151, pp 1.11-1.12) **Thermochemical energy conversion and storage by direct solar heating.** Hunt, A.J.; Ayer, J.; Otto, R. Mar 1987. NTIS, PC A02/MF A01. File Number DE87009270. Contract AC03-76SF00098.

In Energy Conversion and Storage Program: FY 1986, Annual report.

The objective of this research is to investigate the use of concentrated solar energy to drive the endothermic portion of a thermochemical energy storage cycle. This cycle provides means to store energy collected by a solar thermal power plant on clear days and to produce electricity during the night or on cloudy days. The cycle consists of: (1) an endothermic step in which energy is supplied to dissociate the gas, and (2) an exothermic step in which the products of decomposition are combined over a catalyst to provide high-temperatures heat. The heat can be used to operate a turbine or for industrial processes. The decomposition reaction of gases adsorbed on the surface of small particles that act both as the solar absorber and catalyst is being studied. This is an application of the solar reactor known as the STARR (Solar Thermally Activated Radiant Reactor).

40730 **(PB—87-176467/XAB) Parameterization of subsurface heating for soil and concrete using net radiation data.** Doll, D.; Ching, J.K.S.; Kaneshiro, J. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). 1985. 24p. (EPA—600/J-85/478). NTIS, PC A02/MF A01.

Pub. in Boundary-Layer Meteorology, Vol. 32, 351-372(Aug 1985).

The variability of surface sensible heat flux depend strongly on the rate of heating of the underlying surfaces. The variability is expected to be large in urban areas where the surfaces are layered with a variety of man-made materials. Parameterization of the ground heat storage as a function of surface materials is presented based on analyses of the U.S. Environmental Protection Agency's Regional Air Pollution Study (RAPS) conducted in St. Louis, MO. Ground heat flux data are derived from observations of surface and subsurface temperatures for a soil layer and for concrete slabs resting on soil. Simple mathematical expressions giving the ratio of ground heat storage to net radiation as a function of time are presented.

15 GEOTHERMAL ENERGY

1501 Resource Status And Assessment

40731 **(DOE/ID/12526—T3) Geology of the Breitenbush River Area, Linn and Marion Counties, Oregon.** Priest, G.R.; Woller, N.M.; Ferns, M.L. (Oregon State Dept. of Geology and Mineral Industries, Portland (USA)). 1987. Contract FG07-84ID12526. 22p. NTIS, PC A02. File Number DE87013080.

The report is comprised of a geologic map and accompanying descriptive text highlighting structural geology, mineralization, and geothermal resources. (ACR)

40732 **(SAND—87-1573C) Magma energy for power generation.** Dunn, J.C. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 12p. (CONF-8706162—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012104.

From 11. annual geothermal conference and workshop; Oakland, CA, USA (22 Jun 1987).

Thermal energy contained in crustal magma bodies represents a large potential resource for the US and magma generated power could become a viable alternative in the future. Engineering feasibility of the magma energy concept is being investigated as part of the Department of Energy's Geothermal Program. This current project follows a seven-year Magma Energy Research Project where scientific feasibility of the concept was concluded.

1503 Geothermal Exploration And Exploration Technology

40733 **(DOE/ID/12526—T1) Geothermal-gradient data for Oregon, 1982-1984.** Blackwell, D.D.; Black, G.L.; Priest, G.R. (Oregon State Dept. of Geology and Mineral Industries, Portland (USA)). 1986. Contract FG07-84ID12526. 109p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87013078.

This report provides temperature and temperature gradient data for boreholes in Oregon. (ACR)

40734 (SAND—86-1514-Vol.11-No.-1, pp 18-19) **Earth's major heat source: magma.** Apr 1987. NTIS, PC A04/MF A01. File Number DE87009977.

In Sandia technology: Volume 11, No. 1.

Magma bodies at temperatures from 800° to 1200°C exist within the earth's crust at drillable depths. The magma energy program is investigating the feasibility of tapping these reservoirs to obtain high-quality energy. In the first phase of the program (1976 to 1983) the scientific feasibility of extracting energy from magma was examined. The idea was deemed feasible after the following issues had been studied: (1) can magma bodies be located using surface physics and geology; (2) if a body is found, can it be drilled (3) will drilling and extraction materials survive in molten rock, and (4) can energy be extracted from the melt.

40735 (SAND—86-1514-Vol.11-No.-1, pp 24-35) **Tapping the ring of fire: geothermal energy sources.** Apr 1987. NTIS, PC A04/MF A01. File Number DE87009977.

In Sandia technology: Volume 11, No. 1.

Geothermal resources already contribute 1300 MW of power to electric grids in the western US. However, obtaining access to a potential additional 200,000 MW, as well as much more in magma and hot dry rock resources, depends on advances in technology. The feasibility of tapping this energy source is discussed.

1504 Legal And Institutional Aspects

40736 **(DOE/IG—0243) The Department of Energy's collection procedures for defaulted Geothermal Loan Guaranties.** (USDOE Office of Inspector General, Washington, DC. Capital Regional Office). 10 Aug 1987. 10p. OSTI, PO Bx 62, Oak Ridge, TN 37831. File Number TI87013780.

Delays of up to 2 years were experienced in liquidating $9.5 million in collateral on three defaulted loans. Although the Department had paid lenders $32.5 million on these defaulted loans, it had not notified the US Attorney General. Also, it had not prepared final liquidation plans as provided by regulations. As a result of these delays, the collective value of the collateral has decreased by about $2.7 million, and the Department has incurred over $690,000 in lease maintenance and administrative costs. Furthermore, continued delays will result in an estimated $116,000 per year in additional costs and could reduce the chance of collecting approximately $7 million in potential legal damages. The delays in taking action to recover collateral, according to program officials, were due to unresolved legal issues or attempts to restructure a project. Details of findings on the three defaulted loans are given. They were NPN

Partnership and Niland Geothermal, Inc. (Niland), CU-1 Venture (CU-1), and Westmorland Geothermal Associates (Westmorland).

1506 Environmental Aspects And Waste Disposal

40737 **(EGG—2511) Geothermal Injection Technology Program: Annual progress report, Fiscal Year 1986.** (EG and G Idaho, Inc., Idaho Falls (USA); Utah Univ. Research Inst., Salt Lake City (USA)). Jul 1987. Contract AC07-76ID01570. 54p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87012847.

This report summarizes the Geothermal Injection Technology Program major activities in fiscal year 1986. The Idaho Engineering Laboratory (INEL) and the University of Utah Research Institute (UURI) have been conducting injection research and testing for this program, which was initiated in 1983. Activities at the INEL, representative element nodeling of fracture systems based on stochastic analysis, dual permeability modeling of flow in a fractured geothermal reservoir, and dual permeability model - laboratory and FRACSL-validation studies, are presented first, followed by the University of Utah Research Institute tracer development - experimental studies, which includes a brief description of activities planned for FY-1987.

1508 Geothermal Power Plants

40738 **(EPRI-AP—5134-Vol.2) Simulator-analyzer for binary-cycle geothermal power plants: Volume 2, Final report.** (ESSCOR, Solano Beach, CA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jul 1987. 194p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920522.

The objective was to develop a generic dynamic simulator/analyzer for binary-cycle geothermal power plants for use on today's personal computers. The simulator/analyzer, as developed, can be used for (1) Engineering analyses of static/dynamic performance and design trade-offs, (2) Operator training and operating procedure evaluation, and (3) Binary cycle technology demonstration. The simulator/analyzer consists of a set of ordinary non-linear differential equations that are programmed in a simulation language format and solved on an IBM-PC-AT. The equations are driven in an interactive mode by inputs from the PC keyboard and responses of plant temperatures, pressures, flows, etc., can be observed on a real-time color display that replicates a control room interface. Simulation predictions have been validated by comparisons with actual transient and steady state data taken from the Heber Binary Project, a 46.6 MWe binary-cycle demonstration power plant in operation in Southern California. The simulation is accurate to within the uncertainty of the plant's process sensors.

1509 Geothermal Engineering

40739 **(BNL—38945) Potential polymer concrete heat exchanger tubes for corrosive environments.** Fontana, J.J.; Reams, W.; Cheng, H.C. (Brookhaven National Lab., Upton, NY (USA)). Nov 1986. Contract AC02-76CH00016. 11p. (CONF-870946—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87005239.

From 5. international congress on polymers in concrete; Brighton, UK (21 Sep 1987).

It has long been known that carbon steel exposed to some geothermal brines is aggressively attacked, and large corrosion allowances must be made in the design of piping used in such environments. In addition, scaling of the pipes reduces the flow through within a short period of time. Several high temperature polymer concretes have been developed which can be used as non-corrosive liner materials. In addition, polymer concretes with high thermal conductivities have been developed which may be used as heat exchanger tubes for geothermal brines. Studies have indicated that polymer concretes will not scale as rapidly as carbon steel does, thus making them attractive alternatives for heat exchanger tubes. Thin walled, thermally conductive polymer concrete tubes have been made that can withstand pressures >4.1 MPa at 150°C without leaking. Continuing studies are being made to characterize these materials and evaluate them for heat exchanger applications.

40740 (SAND—86-1514-Vol.11-No.-1, pp 36-37) **What's going on down there: geoscience research drilling office.** Apr 1987. NTIS, PC A04/MF A01. File Number DE87009977.

In Sandia technology: Volume 11, No. 1.

Researchers are now using the drill bit as a research tool to investigate the third dimension of the earth's crust. To help understand processes occurring far beneath the authors feet, drilling programs have been established in the US and in other countries for the purpose of drilling deep into scientifically interesting regions of earth's crust to answer questions such as: how is heat transferred from depth to the surface, what are the fluid dynamics in the crust, how are hydrothermal systems developed and maintained, when and where are minerals deposited, and what are the fundamental processes in volcanic eruptions? These drilling efforts are discussed.

1520 Geothermal Data And Theory

REFER ALSO TO CITATION(S) 40737

17 WIND ENERGY

REFER ALSO TO CITATION(S) 40716

1701 Availability (climatology)

40741 **(NP—7770191) Determination of natural wind conditions in German coastal regions using a mesoscale model.** Theunert, S. (Hannover Univ. (Germany, F.R.). Inst. fuer Meteorologie und Klimatologie; Hannover Univ. (Germany, F.R.). Fachbereich Physik). 1986. 144p. (In German). NTIS (US Sales Only), PC A07. File Number DE87770191.

A strategy for selecting wind power plant sites at the German North Sea coast was determined on the basis of numerical wind field simulations. The applicability of a mesoscale model is discussed in a comparison of different model types. The main factor was the variety of wind situations in the Central European climate, as well as the mesoscale-type influence of the land/sea interface on the wind field structure.

40742 **(PNL-SA—14865) Resource assessment methods, siting, and performance evaluation.** Aspliden, C.I.; Elliott, D.L.; Wendell, L.L. (Pacific Northwest Lab., Richland, WA (USA)). Mar 1987. Contract AC06-76RL01830. 59p. (CONF-8605282—1). NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87011985.

From Wind and solar short course; Modena, Italy (5 May 1986).

The availability and monitoring of wind resource are discussed. Wind availability for wind turbine energy production is also of interest. (BCS)

1706 Wind Energy Engineering

REFER ALSO TO CITATION(S) 40741

40743 **(CONF-850834—9) Wind energy utilization. Status of research and development in the Federal Republic of Germany.** Windheim, R. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Projektleitung Energieforschung). 1985. 18p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87770184.

From WINDPOWER '85; San Francisco, CA, USA (27 Aug 1985).

Most of the wind energy R & D activities of the Federal Republic of Germany are covered by the Program for Energy Research and Technologies of the Minister of Research and Technology. It follows the general objective to develop reliable and economically viable wind energy conversion systems and to stimulate the commercialization of wind power. Realistic site evaluation shows that the wind energy potential in the Federal Republic of Germany is notable. Many projects are or were supported by the program with a total amount of more than 200 mill. DM. They

follow two aims: 1. Electricity generation by small scale (up to 50 kW), medium scale (several 100 kW) and large scale machines (several MW). 2. Adaptation of small and medium scale machines for special applications. The status of R & D projects is presented. It supports the objective to utilize the wind as one promising way in the scenario of renewable energy sources.

40744 **(DOE/BP—653) The world's first multi-megawatt wind farm: Construction of the MOD-2 wind turbine generators at the Goodnoe Hills, Washington to evaluate a new source of renewable energy.** (USDOE Bonneville Power Administration, Portland, OR). Aug 1986. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87001327.

The three MOD-2 wind turbines at the Goodnoe Hills near Goldendale, Washington, make up the first multi-megawatt electric power wind farm in the world. They are part of a great experiment, which, if it succeeds, may launch a new age of wind power development. The MOD-2 is a research and development project with considerable research costs and one-of-a-kind construction costs in its budget. It does not generate power as cheaply as a coal or nuclear plant. But future wind turbines based on the MOD-2 design or similar designs may. The success of the MOD-2 design will help realize the goal of cost-competitive power generation from the wind. This booklet reviews some of the events which brought the MOD-2 installation at the Goodnoe Hills into being, and briefly describes the components of the wind machines and elements of the research test program.

40745 **(DOE/NASA—0330-2) Wind tunnel evaluation of a truncated NACA 64-621 airfoil for wind turbine applications.** Law, S.P.; Gregorek, G.M. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Jul 1987. Contract AI01-76ET20320. 37p. (NASA-CR—180803). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013124.

An experimental program to measure the aerodynamic performance of a NACA 64-621 airfoil with a truncated trailing edge for wind turbine applications has been conducted in the Ohio State University Aeronautical and Astronautical Research Laboratory 6 in. x 22 in. pressurized wind tunnel. The blunted or trailing edge truncated (TET) airfoil has an advantage over similar sharp trailing edge airfoils because it is able to streamline a larger spar structure, while also providing aerodynamic properties that are quite good. Surface pressures were measured and integrated to determine the lift, pressure drag, and moment coefficients over angles of attack ranging from -14° to +90° at Mach 0.2 and Reynolds numbers of 1,000,000 and 600,000. Results are compared to the NACA 0025, 0030, and 0035 thick airfoils with sharp trailing edges. Comparison shows that the 30% thick NACA 64-621-TET airfoil has higher maximum lift, higher lift curve slope, lower drag at higher lift coefficients, and higher chordwise force coefficient than similar thick airfoils with sharp trailing edges.

40746 **(EPRI-AP—5219) Specification of test equipment for power electronic drive research: Final report.** Porter, D. (Omnion Power Engineering Corp., Mukwonago, WI (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jun 1987. 106p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920504.

This report describes the methodology employed to specify an automated dynamometer for testing advanced, variable speed generators and motors. The system has been specifically designed to quantify the electrical and mechanical impacts of operating wind systems with rated outputs of up to 100 kilowatts in the variable speed mode. However, in that the dynamometer is capable of both supplying and absorbing energy, it is equally suitable for testing advanced, variable speed drives. To accomplish these tasks, an automated dynamometer was first conceptualized and then specified that would perform a series of tests to completely understand the performance of a variable speed wind turbine generator. The costs associated with procuring, assembling and testing and the dynamometer are identified.

40747 **(SAND—87-0792) The LIFE computer code: Fatigue life prediction for vertical axis wind turbine components.** Sutherland, H.J.; Ashwill, T.D.; Slack, N. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1987. Contract AC04-76DP00789. 69p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87013400.

The LIFE computer code was originally written by Veers to analyze the fatigue life of a vertical axis wind turbine (VAWT) blade. The basic assumptions built into this analysis tool are: the fatigue life of a blade component is independent of the mean stress; the frequency distribution of the vibratory stresses may be described adequately by a Rayleigh probability density function; and damage accumulates linearly (Miner's Rule). Further, the yearly distribution of wind is assumed to follow a Rayleigh distribution. The original program has been updated to run in an interactive mode on a personal computer with a BASIC interpreter and 256K RAM. Additional capabilities included in this update include: the generalization of the Rayleigh function for the wind speed distribution to a Weibull function; the addition of two constitutive rules for the evaluation of the effects of mean stress on fatigue life; interactive data input; and the inclusion of a stress concentration factor into the analysis.

40748 **(SAND—87-7012) A design code to study vertical-axis wind turbine control strategies.** Vachon, W.A. (Vachon (W.A.) and Associates, Inc., Manchester, MA (USA); Sandia National Labs., Albuquerque, NM (USA)). Jul 1987. Contract AC04-76DP00789. 33p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87012499.

A computer code called ASYM is described. The code permits a wind turbine designer to examine the role of low and high wind speed cut-in and cutout control strategies on the production of energy and the consumption of fatigue life by a wind turbine. The primary goal of the code development has been to create a design tool to optimize the energy production and the fatigue life of a wind machine through optimized high wind speed control schemes. The code is also very useful in evaluating start-up algorithms. It works primarily in the time domain and simulates high-frequency random wind of specific statistical characteristics while employing energy and damage density functions to calculate the results. A modified net present value calculation of the annual machine revenues and costs over the calculated life of the wind turbine is used to compare the merits of various control algorithms. Typical results are provided to demonstrate the use of the code.

40749 **(SERI/STR—217-3163) Lifting surface performance analysis for horizontal axis wind turbines.** Kocurek, D. (Solar Energy Research Inst., Golden, CO (USA)). Jun 1987. Contract AC02-83CH10093. 312p. NTIS, PC A14/MF A01; 1; GPO Dep. File Number DE87001176.

This report describes how numerical lifting-surface theory is applied to the calculation of a horizontal-axis wind turbine's aerodynamic characteristics and performance. The report also describes how such an application is implemented as a computer program. The method evolved from rotary-wing and helicopter applications and features a detailed, prescribed wake. The wake model extends from a hovering-rotor experimental generalization to include the effect of the windmill brake state on the radial and axial displacement rates of the trailing vortex system. Performance calculations are made by coupling the lifting-surface circulation solution to a blade-element analysis that incorporates two-dimensional airfoil characteristics as functions of angle of attack and Reynolds number. Several analytical stall models are also provided to extend the airfoil characteristics beyond the limits of available data. Although this work focuses on the steady-performance problem, the method includes ways to investigate the effects of wind-shear profile, tower shadow, and off-axis shaft alignment. Correlating the method to measured wind-turbine performance, and comparing it to blade-element momentum theory calculations, validate and highlight the extreme sensitivity of predictions to the quality of early post-stall airfoil behavior.

40750 **Wind turbine with damper.** Kenfield, J.A.C. (to Minister of Energy and Natural Resources, Edmonton). US Patent 4,674,954. 23 Jun 1987. Filed date 4 Feb 1986. vp.

This patent describes a horizontal axis wind turbine assembly comprising: a rotor assembly having delta wing blades; a head assembly secured at one end to the rotor assembly and being mountable on a tower so as to pivot about a vertical yaw axis; a tail assembly pivotally mounted on the other end of the head assembly, so as to pivot about a vertical axis, the assembly having one or more upstanding tail surfaces which cooperate with the wind to cause the assembly to track the wind; the central axis of the rotor assembly being offset from the vertical plane of the yaw axis; A wind force acting on the blades will generate a moment about the yaw axis; moment urges the rotor assembly to pivot from an operative position, transverse to the wind, toward a feathered position, edgeways to the wind flow; the tail assembly continues to track the wind; means, connected with the head assembly, for applying a counterbalancing counter-rotational moment to the head assembly to resist the wind moment; a container, mounted in the wind turbine assembly, for containing a reservoir of hydraulic fluid; a double-acting cylinder being pivotally connected with the head and tail assemblies so as to resist pivoting movement of the head assembly about the yaw axis; hydraulic fluid lines interconnecting the reservoir and the two ends of the cylinder chamber; and means for controlling the rate of fluid movement through each of the lines.

40751 **Input turbulence features at a megawatt-size wind turbine Medicine Bow, Wyoming.** Connell, J.R.; Morris, V.R.; Hinchee, M.E. (Pacific Northwest Lab., Richland, WA). pp 201-214 of Sixth ASME wind energy symposium. Thresher, R.W. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870210—). Contract AC06-76RL01830.

From 10. energy sources technology conference and exhibition; Dallas, TX, USA (15 Feb 1987).

Analysis of the winds at the Medicine Bow site reveals data analyzed to characterize the wind in terms of fixed-point, single-tower properties and model the wind properties as they would be experienced by points on rotating turbine blades. The STRS-2 model converts single-tower wind characteristics to be measured from an array of towers arranged in a crosswind line covering the rotor disk. A response function for the flatwise root bending moment of one of the WTS-4 turbine blades is computed using the turbine data and the STRS-2 data.

40752 **An engineering method for modeling the structural elastic parameters of composite wind turbine blades.** Stoddard, F.S.; Nelson, V.C. (Alternative Energy Institute, West Texas State Univ., Canyon, TX). pp 197-198 of Sixth ASME wind energy symposium. Thresher, R.W. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870210—).

From 10. energy sources technology conference and exhibition; Dallas, TX, USA (15 Feb 1987).

The author presents a method for developing a suitable engineering model of a geometrically and structurally complex composite wind turbine blade. The blades are usually highly twisted and tapered, have variation in mass and stiffness properties in both spanwise and chordwise directions, and employ various forms and orientations of reinforcement. The results are presented for the 20-meter diameter Carter Wind Systems 300-kW glass-epoxy rotor blade illustrating the wide variation in the section properties which would be achieved by: composite analysis alone; static deflection empirical tests alone; natural frequency tests alone; and the present method which combines all three.

40753 **Fatigue LIFE prediction for VAWT components using the life codes.** Sutherland, H.J.; Ashwill, T.D. (Wind Energy Research Div., Sandia National Labs., Albuquerque, NM). pp 193-196 of Sixth ASME wind energy symposium. Thresher, R.W. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870210—). Contract AC04-76DP00789.

From 10. energy sources technology conference and exhibition; Dallas, TX, USA (15 Feb 1987).

This manuscript describes a new code, the LIFE2 code. After a discussion of the computational philosophy, an example problem is used to illustrate the fracture mechanics analysis techniques that will be employed in the code. The manuscript closes with an outline of the material characterization studies that are being conducted on specialized blade materials to provide the necessary constitutive description(s) required by the code.

40754 **Dynamic stall measurements on wind turbine airfoils.** Gregorek, G.M.; Hoffmann, M.J. (The Ohio State Univ., Columbus, OH). pp 191-192 of Sixth ASME wind energy symposium. Thresher, R.W. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870210—).

From 10. energy sources technology conference and exhibition; Dallas, TX, USA (15 Feb 1987).

The author discusses the angle of attack and surface pressure data sensed via potentiometer and moderate response pressure sensing system, respectively. Each test point generated 128 pressure distributions reduced to normal, axial and moment coefficients in near online time. Results indicate a measureable and significant sensitivity to the forcing function for any given model. Sinusoidal motion data compared to inverse tangent motion data demonstrates the effect of angle of attack time history while increasing reduced frequency reveals growing hysteresis in the aerodynamic coefficients against angle of attack. Details of the oscillating mechanisms, the data acquisition and reduction system, and accumulated data sets are discussed.

40755 **Rotor dynamic response measurements.** Hock, S.; Thresher, R. (Solar Energy Research Institute, Golden, CO). pp 177-178 of Sixth ASME wind energy symposium. Thresher, R.W. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870210—).

From 10. energy sources technology conference and exhibition; Dallas, TX, USA (15 Feb 1987).

The author discusses three key signals examined in the rotor dynamic response measurement. They include the root bending moment, the teeter angle, and the mechanical torque of the rotor. The power curve as computed using the mean torque for the ten-minute segments is given. The data reduction includes the azimuth averaging approach which bins the data according to blade azimuth position. The tests used 6^0 wide bins for this study averaging times of one minute, ten minutes, and one hour. The azimuth averaged signal represents the deterministic response for the time period, and the difference between the original time series and the azimuthal average represents the stocastic response. Examples an azimuthally averaged root bending moment for the three averaging times, and show the corresponding standard deviations.

40756 **On uncertainties in power performance measurements.** Frandsen, S. (Wind Energy Research Center, Solar Energy Research Institute, Golden, CO). pp 157-170 of Sixth ASME wind energy symposium. Thresher, R.W. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870210—). Contract AC02-83CH10093.

From 10. energy sources technology conference and exhibition; Dallas, TX, USA (15 Feb 1987).

In this paper, the various contributions to the overall uncertainty of the power curve of a wind turbine are evaluated in general terms, defining the annual mean power from the wind turbine to be a relevant measure of the power curve's uncertainty. Thorough considerations have led to the definition of five error categories. To the extent possible, each of the error types is evaluated and formulas are suggested for some of the errors.

40757 **Modal testing of the EOLE wind turbine.** Carne, T.G.; Lauffer, J.P.; Gomez, A.J.; Benjanet, H. (Experimental Mechanics Dept., Sandia National Labs., Albuquerque, NM). pp 67-68 of Sixth ASME wind energy symposium. Thresher, R.W. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870210—).

From 10. energy sources technology conference and exhibition; Dallas, TX, USA (15 Feb 1987).

This paper discusses modal testing for large rotating wind turbines, modal parameters are particularly important since the applied forces acting on the turbine have large periodic components at integral multiples of the rotation speed. During the design process, analytical or finite element models must be depended upon for estimates of the modal parameters. When the turbine hardware becomes available for testing, the actual modal parameters can be

measured. Measured data can then be used to update the analytical predictions or modify the model. The modified model can then be used to re-evaluate the adequacy of the structural design or the chosen operating speed.

40758 **Data acquisition and analysis system for the Sandia 34-meter vertical axis wind turbine.** Berg, D.E. (Wind Energy Research Div. 6225, Sandia National Labs., Albuquerque, NM). pp 55-56 of Sixth ASME wind energy symposium. Thresher, R.W. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870210—). Contract AC04-76DP00789.

From 10. energy sources technology conference and exhibition; Dallas, TX, USA (15 Feb 1987).

This presentation discusses data acquisition philosophy, expands on the existing capabilities of software and hardware, and presents plans for further software development and hardware enhancement.

40759 **Loads and free yaw characteristics of the ESI-80.** Butterfield, C.P. (Solar Energy Research Institute, Golden, CO). pp 31-32 of Sixth ASME wind energy symposium. Thresher, R.W. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870210—).

From 10. energy sources technology conference and exhibition; Dallas, TX, USA (15 Feb 1987).

This report examines the yaw characteristics of a teetered, fixed pitch, free yaw, 24.40-meter diameter wind turbine. The affects of yaw conditions on blades are presented. Typical yaw rates are shown as well as yaw stability and yaw tracking error for various wind conditions. Yaw characteristics for the ESI-80 are compared with other teetered rotors. This data and additional data shown in this report imply that teetering rotor loads are relatively unaffected by yaw errors and yaw rates which result from shifting wind direction. Free yaw response is highly damped. Finally, free yaw stability and zero yaw tracking error can be achieved using teetered rotors but appear to be configuration dependent.

40760 **Status of the special purpose airfoil families.** Tangler, J.L.; Somers, D.M. (Solar Energy Research Institute, Golden, CO). pp 17-18 of Sixth ASME wind energy symposium. Thresher, R.W. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870210—).

From 10. energy sources technology conference and exhibition; Dallas, TX, USA (15 Feb 1987).

This article details how the thick airfoil family has followed a development path similar to the thin airfoil family. The motivation for developing the thick airfoil family was the need to satisfy the structural needs of larger rotors and blades housing servo motors for movable tip sections or control surfaces. The design of the three airfoils comprising the thick airfoil family has been completed along with the wind-tunnel test of the primary outboard member of the airfoil family. Two-dimensional results from the Delft low turbulence wind-tunnel substantiated the design characteristics of the airfoil. Final validation of the thick airfoil family's performance characteristics will be through a competitive procurement to atmospheric test the airfoil family on a 20 to 30-meter rotor.

40761 **A comparison of predicted wind turbine blade loads to test measurements.** Wright, A.D.; Thresher, R.W. (Solar Energy Research Institute, Wind Energy Research Center, Golden, CO). pp 9-16 of Sixth ASME wind energy symposium. Thresher, R.W. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870210—).

From 10. energy sources technology conference and exhibition; Dallas, TX, USA (15 Feb 1987).

This paper describes modifications and comparisons of predicted blade bending moments to test measurements. Wind tunnel data for a 1/20th scale model will be used to compare FLAP predictions for the cyclic flap-bending moments at the 33% spanwise station for three different wind speeds. The comparisons will be made for both rigid and teetering hubs. Currently, the FLAP code accounts for deterministic excitations such as wind shear, tower shadow, gravity, and prescribed yawing motions. Conclusions will be made regarding the code's accuracy in predicting the cyclic bending moments.

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REFER ALSO TO CITATION(S) 40338, 40339, 40407, 40408, 40409, 40410, 40411, 40822, 40827, 40838, 40839, 40840, 40898, 40935, 41082, 41292, 41594

40762 (EPRI-AP—5190, pp 1.1-1.21) **Engineering, procurement, and construction of gas turbine power plants.** Soroka, G.E.; Kassel, H.S. May 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920429.

In Gas turbine procurement and combined-cycle repowering: 1986 workshop: Final report.

The design, procurement, and construction of gas turbine power plants are presented in outline form. The information is presented under the following topics: client/engineer division of responsibility; major project activities; Bechtel's plan of study approach; regulatory filings/issues; bid evaluation topics; generic schedule-utility combined cycle project; important plant features; and benefits of owners representative located at A/E offices.

40763 (EPRI-AP—5190, pp 2.1-2.35) **Specifications and purchase of gas turbine generator set.** Zanyk, J.P. (Dow Chemical, Canada, Ltd.). May 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920429.

In Gas turbine procurement and combined-cycle repowering: 1986 workshop: Final report.

The specification and purchase of a gas turbine generator set is more than the purchase of the physical machine to convert fuel energy to electric energy. Critical to the reliability and good performance of the gas turbine generator set is a great deal of auxiliary equipment that goes along with the total package as supplied by the gas turbine manufacturer. The controls for the gas turbine. The starting motor or diesel, the lube oil pumps and filters, lube oil tank and power supply are but a few items that are critical pieces of equipment needed to operate the plant. The specifications for purchase of gas turbine generator sets are presented.

40764 (EPRI-AP—5190, pp 3.1-3.13) **Accessories, controls, and instrumentation.** Dolbec, A.C.; Knauf, C.L. (Electric Power Research Institute, Palo Alto, CA). May 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920429.

In Gas turbine procurement and combined-cycle repowering: 1986 workshop: Final report.

In many studies of the performance of gas turbines it has been evident that controls, accessories, and instrumentation have had a major influence on availability and reliability. One study performed by General Electric Co. points out various means of ranking the performance of combined-cycle systems. A review of this report provides some insight into the past performance of combined-cycle plants. In a follow-on effort under EPRI Project RP2467, General Electric Co. addressed the areas of most concern, namely controls, instrumentation, and accessory systems. The object of the study has been to apply reliability engineering to these systems and improve them for future model offerings. The goals established for this study for a combined-cycle plant operating on gas fuel are presented. The plant arrangement is a single gas turbine, heat recovery steam generator, steam turbine and generator all connected as a single shaft. The overall plant availability goal is 90% and the starting reliability is 95%.

40765 (EPRI-AP—5190, pp 4.1-4.15) **Combustion turbine procurement: a recent experience.** Sockwell, J.E. Jr.; Gray, D.C. (Texas Utilities Generating Co.). May 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920429.

In Gas turbine procurement and combined-cycle repowering: 1986 workshop: Final report.

Texas Utilities Electric Company (TUEC) is a large, investor-owned company which, through its divisions of Dallas Power and Light Company, Texas Electric Service Company, and Texas Power and Light Company, serves over 5,000,000 people in 351

cities and towns in North Central, East, and West Texas. To support this large service area, Texas Utilities Generating Company (TUGCo), another division of TUEC, has the responsibility of planning, designing, constructing, operating, and maintaining power plants in the TUEC system. In 1985, the total net generating capability of TUGCo was 17,804 MW. Approximately 48% of the electric energy generated was from lignite fired power plants, with gas/oil units and other sources supplying the other 52%. Contrasting with the experience of many utilities in the US, the TUEC system has had peak load growth averaging approximately 6% over the past few years. TUGCo's methodology for becoming familiar with combustion turbines, for identifying potential problem areas, for working with equipment suppliers to get special machines that meet particular needs, and for evaluating vendor proposals is described.

40766 (EPRI-AP—5190, pp 6.1-6.54) **Repowering Burlington Unit 7.** Zwillenberg, M.L.; Morphet, J. Jr.; Oliker, I.; Silaghy, F. (Public Serve Electric and Gas Co.). May 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920429.

In Gas turbine procurement and combined-cycle repowering: 1986 workshop: Final report.

Many utilities have existing steam generating capacity and simple cycle gas turbine generation capacity which are used in intermediate or peaking-duty generation, and in some cases, as standby capacity only, because of poor heat rates. There may be opportunities for these utilities for repowering by combining such facilities to produce some form of combined cycle having a better heat rate than its individual components. The use of combustion turbine exhausts in various ways may make this possible while conforming to emission regulations. Repowering is the improvement of heat rate and capacity at an existing fossil-fueled power plant by rearranging existing equipment components or adding new components. More specifically, repowering is the utilization of combustion turbines and a steam Rankine cycle combined in such a way that the exhaust heat from the combustion turbines is used as, or contributes to the heat input of the Rankine cycle. EPRI called for three site specific studies by three different utilities on conceptual designs and economic evaluation of different repowering schemes. The repowering of the Unit #7 of the Burlington Generating Station of Public Service Electric and Gas Company (PSE & G) is described.

40767 (EPRI-AP—5190, pp 7.1-7.36) **Combined cycle repowering - two concepts at Virginia Power.** Rives, J.D.; Letarte, J.R.; Catina, J.L. May 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920429.

In Gas turbine procurement and combined-cycle repowering: 1986 workshop: Final report.

A study was undertaken to determine the engineering and economic feasibility of repowering several conventional pulverized coal and oil fired units with combustion turbines. Both feedwater repowering and hot windbox repowering were examined. Performance was evaluated using PEPSE. The results of the most promising units are presented in detail. The duration of the study was six months and the project cost approximately $75,000.

40768 (EPRI-AP—5190, pp 8.1-8.27) **Repowering Northeast Utilities Devon Station.** Rorstrom, E.G.; Pishko, D.A.; Willson, E.J. Jr. May 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920429.

In Gas turbine procurement and combined-cycle repowering: 1986 workshop: Final report.

NUSCO's interest in performing the Devon Repowering Study originated from its need to select a generating technology that would allow flexibility in both construction schedule and fuels without incurring a significant economic penalty; and to determine the practicality of reutilizing its seven non-reheat units which are approaching their scheduled retirement. Earlier studies had indicated that life extension programs for the non-reheat units would not be economical; repowering of the non-reheat steam turbines as part of a combined cycle provided opportunities for staged construction; and advancements in combustion turbine to increase reliability and efficiency were necessary to produce competitive economics. The feasibility of repowering the Devon Station is discussed.

40769 (EPRI-AP—5190, pp 9.1-9.10) **Repowering Chesterfield 1 and 2 with combined cycle.** Catina, J.L.; Fortune, H.J. Jr.; Soroka, G.E. May 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920429.

In Gas turbine procurement and combined-cycle repowering: 1986 workshop: Final report.

Virginia Power has recently completed a detailed study for repowering two retired units at the Chesterfield Station with 300 to 400 MW of combined cycle power as required by the 1985 load growth forecast. The study involved economic and technical assessments of combined cycle equipment and integration of existing facilities. Evaluations of peaking and base load characteristics, fuels, and steam cycles were performed to establish the optimum performance and cycle configuration. An integrated coal gasification plant was also sited and evaluated but is not discussed. During the progress of this study, certain external factors were changing and are noted where appropriate.

40770 (EPRI-AP—5190, pp 10.1-10.36) **Repowering Midland Nuclear Unit 1.** Bauman, R.C.; Harris, D.E. (Consumers Power Co., Jackson, MI). May 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920429.

In Gas turbine procurement and combined-cycle repowering: 1986 workshop: Final report.

In July 1984, Consumers Power Company terminated construction of its Midland nuclear plant due to its inability to finance the project. The total investment in the project was $4.1 billion. The plant has been carefully shut down and maintained to preserve its value and the Company's options regarding ultimate disposition of the facility. A Midland Options Study was commissioned and performed by the Company to compare various options for the 85% complete facility against the alternative of abandonment. A detailed report of the study was released in April 1986. This presentation emphasizes the preferred option (reference case) for converting Midland to a natural gas fueled combined-cycle plant using new gas turbine/heat recovery steam generators supplying steam to the existing steam turbine. The other options which were evaluated i.e., conversion to a coal-fired plant and nuclear completion, are summarized.

40771 **(EPRI-AP—5324) Benefits of battery storage as spinning reserve: Quantitative analysis: Final report.** Zaininger, H.W. (Zaininger Engineering Co., San Jose, CA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jul 1987. 63p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920527.

This analysis evaluated the previously unquantified economic benefits of replacing spinning reserve with electricity stored in batteries. According to the calculations, day-to-day operations for a typical 2000-MW generating system with 100 MW of battery storage yielded annual production cost savings of $4.35 million.

40772 (EPRI-CS/NP—3016-Vol.4B, pp 3.35-3.41) **Air/gas dynamics modeling.** Smith, L.P. Apr 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920392. (CONF-8409396—Vol.4B).

From Workshop on Modular Modeling System (MMS); New Orleans, LA, USA (26 Sep 1984).

The motivations for dynamic analysis of the air/gas side of fossil boilers and to how this capability can be incorporated into the Modular Modeling System (MMS) are discussed. The potential generic applications of air/gas dynamics are discussed, some detail on the stack liner implosion experienced TVA at their Cumberland plant, and how dynamic analysis might have been used to avoid the occurrence and was used to avoid re-occurrence are reported. EPRI has released the results of research project RP 1651. One of the results of that project, by the Massachusetts Institute of Technology, was the development of an air/gas dynamics code - DUCSYS. It analyzes the air/gas side using exactly the same assumption that the steam/water and air/gas sides may be decoupled that MMS uses. One of the objectives of this study was to indicate the applications of each code, how they may be coordinated, and where further development work is required.

40773 (EPRI-CS/NP—3016-Vol.4B, pp 6.3-6.17) **Evaluation of turbine and superheater bypass system.** Raghavan, R.; Gupta, G.D.; Cha, C.K. (Foster Wheeler Development Corp., Livingston, NJ). Apr 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920392. (CONF-8409396—Vol.4B).

From Workshop on Modular Modeling System (MMS); New Orleans, LA, USA (26 Sep 1984).

Under EPRI Contract RR1184-3-1, Foster Wheeler Development Corporation is developing a turbine bypass model to evaluate the MMS fossil modules. The Seminole coal fired steam generation plant, the MMS model developed, and the results of a full load rejection transients are described. Problems encountered during development are also briefly described.

40774 (EPRI-CS/NP—3016-Vol.4B, pp 6.21-6.43) **EPRI plant analyzer. Part I. System description and fossil plant applications.** Ipakchi, A.; Khadem, M.; Chen, H.; Taft, C.W.; Wong, F.K.L. (Systems Control, Inc., Palo Alto, CA). Apr 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920392. (CONF-8409396—Vol.4B).

From Workshop on Modular Modeling System (MMS); New Orleans, LA, USA (26 Sep 1984).

Results are presented of a project sponsored by EPRI to design and develop an interactive and color graphics based software environment for operation of dynamic simulation codes such as the MMS. The system is called Plant Analyzer and can be applied to engineering and training applications in the utility industry. The Plant Analyzer's general design and system description are presented. Interim results of its application to a fossil plant (Lansing Smith Unit 2) is presented, for which two MMS plant models with different complexity have been interfaced with user graphic displays. Several displays have been developed. A top level display presents the plant components with the associated steam and water cycles. Lower level displays give detail results for the furnace and feed water chain. Several control panels are also implemented for interactive actuation of control functions. Manpower statistics for this project is given.

40775 (EPRI-CS/NP—3016-Vol.4B, pp 6.47-6.58) **Steam attemperation control system study of a fossil unit.** Tederington, T.L.; Durrani, J. (Detroit Edison, MI). Apr 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920392. (CONF-8409396—Vol.4B).

From Workshop on Modular Modeling System (MMS); New Orleans, LA, USA (26 Sep 1984).

As a new coal-fired plant (Belle River Unit 1) was being prepared for start-up, some concern over the stability of the control system arose. A dynamic model of the superheat steam attemperation system and steam temperature controls was developed using the Modular Modeling System (MMS). This is the first fossil unit modeled at Detroit Edison using the modular Modeling System. This study demonstrates that MMS is a good tool for investigating plant performance. It also shows that MMS can be used for developing, tuning and analyzing a complex control system. The steam and control systems were modeled and analyzed by introducing various upsets into the system. The results indicate that the steam temperature control system will function to maintain stable operating conditions and ensure reliable operation. Additional simulation studies and fine tuning will continue as field data become available.

40776 (EPRI-CS/NP—3016-Vol.4B, pp 6.61-6.74) **SDG & E Encina Unit 4 startup optimization.** Ishii, R.K. (San Diego Gas & Electric Co., CA). Apr 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920392. (CONF-8409396—Vol.4B).

From Workshop on Modular Modeling System (MMS); New Orleans, LA, USA (26 Sep 1984).

A Modulator Modeling System (MMS) simulation of Encina Unit 4 is being developed. Results will be used to develop refined startup procedures for this particular unit, and will also illustrate MMS code capabilities to management and plant engineers. Steady-state analyses of power plants has been, and is a valuable performance tool. It has aided performance engineers in locating lost BTU's and assessing heat rate improvement projects. However, the current operating state of power plants is more dynamic than in past years. Subsequently the present plant simulation capabilities are limited to, at best, an estimate of unit performance. A transient model, such as MMS, meets the requirements necessary to assess plant performance over a range of plant dynamic modes. This becomes particularly critical during unit load ramping, startup, shut down, and emergency response operation. The objective of this project is to develop startup guidelines for the Encina Unit 4 operators, utilizing the MMS code, to reduce startup fuel consumption while minimizing rotor life expenditure.

40777 (EPRI-CS/NP—3016-Vol.4B, pp 6.77-6.100) **Modular modeling as a tool for the analyses of startup strategies.** Dixon, R.R.; Smoak, R.A. Apr 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920392. (CONF-8409396—Vol.4B).

From Workshop on Modular Modeling System (MMS); New Orleans, LA, USA (26 Sep 1984).

Much of the current work within the industry on cycling improvement address plant equipment modifications to minimize startup time, costs, and stresses. This project addresses a quantitative method for arriving at the best startup procedure given a fixed plant configuration. The method is equally useful for evaluating the benefits of equipment modifications. The use of MMS, in conjunction with an analytical cost function, to evaluate startup strategies for a cycling plant is described. An MMS model was constructed with sufficient detail to allow simulation of startup from lightoff, through turbine roll, and up to full power. The model was used to generate transient data in the boiler and turbine for two different startup procedures. This data were then used to calculated major boiler and turbine component life expenditures based on creep and thermal cycling analyses. Ultimately, the life expenditure was converted to repair or replacement costs and added to fuel costs and generation error costs for a total startup cost. This final cost figure provided a quantitative measure of startup costs for the selected procedure. By comparing the costs of one procedure against those of others, the best startup procedure can be selected.

40778 **(GEPP-TIS—1016) Gases released by surface flashover of insulators.** Miller, H.C.; Ney, R.J. (General Electric Co., Largo, FL (USA). Neutron Devices Dept.). 20 Jul 1987. Contract AC04-76DP00656. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013851.

The gases released by surface flashovers on alumina ceramics, Pyrex glass, and quartz, using 20-μs voltage pulses were investigated using an ion pumped metal vacuum system. Appreciable quantities of gas were measured (approximately 10^{-6} torr-liters or 10^{13} molecules). The composition of this gas differed significantly from the background gas. The dominant species in the surface flashover gases were CO_2, CO, and H_2; a modest amount of CH_4 was observed, along with lesser quantities of N_2 and H_2O. The dominant gas in the system background was nitrogen, accompanied by (in decreasing amounts) H_2, H_2O, CO/CO_2, Ar, CH_4, and He. We concluded that the gas released by flashovers on the surface of the insulators was not absorbed system background gas, but was gas adsorbed during the handling and processing of the insulator.

40779 (INIS-mf—10706, pp 1-9) **Operational experience gained with the Voelklingen power plant.** Brocke, W. (Saarbergwerke A.G., Saarbruecken, Germany, F.R.). 1986. (In German). NTIS (US Sales Only), PC A16/MF A01. File Number DE87752788. (CONF-8605275—).

From VGB special meeting on Yugoslavia; Bled, Yugoslavia (14 May 1986).

The Voelklingen project power plant is an operational demonstration plant for a novel black-coal-fuelled power plant type. Its design concept is based on low-pollution power production from black coal, on the application of particularly inert-rich fuels and on an improvement of system efficiencies. The author analyses the engineering core of the power plant comprising the combination of a FBC system with a hot-air gas turbine and a coal-dust-fuelled steam generator, while focussing on the implementation of a measurement programme performed on the discharge of the flue gases through natural-draft cooling towers to study diffusion and conversion processes. In addition he describes experience gained with atmospheric FDC technology. (HAG).

40780 (INIS-mf—10706, pp 1-34) **Extension of and operating experience with the Nikola Tesla power plant.** Deleon, E. 1986. (In German). NTIS (US Sales Only), PC A16/MF A01. File Number DE87752788. (CONF-8605275—).

From VGB special meeting on Yugoslavia; Bled, Yugoslavia (14 May 1986).

The author describes the extension of the Nikola Tesla power plant in Yugoslavia. The general design concept of Unit B is presented based on its extension including planning and investment. Arrangement, construction activities, fuel properties, and various systems like steam boiler, turbine and generator are described. Unit commissioning, boiler blow-out and start-up are examined and the control and dynamic properties of the plant and its guaranteed values are reviewed. (HAG).

40781 (INIS-mf—10706, pp 1-22) **Evolution of power plant engineering in the Federal Republic of Germany till 2020.** Spalthoff, F.J.; Schwarz, O. 1986. (In German). NTIS (US Sales Only), PC A16/MF A01. File Number DE87752788. (CONF-8605275—).

From VGB special meeting on Yugoslavia; Bled, Yugoslavia (14 May 1986).

The author attempts to forecast the possible developments in energy consumption and power plant technology for the FRG beyond the year 2000. He describes today's situation and energy economy aspects including pollution control requirements, primary energy and electricity consumptions, and focusses on the development of major energy carriers, coal grades and types, various combustion technologies like fluidized-bed combustion, combined processes, heat and power cogeneration, nuclear energy and additional energies like solar, tidal, wind, geothermal and biomass energies. (HAG).

40782 (INIS-mf—10706, pp 1-8) **Experiences gained with the pressurized fluidized-bed system at the Aachen RWTH.** Dibelius, G.; Pitt, R.; Croonenbrock, R. 1986. (In German). NTIS (US Sales Only), PC A16/MF A01. File Number DE87752788. (CONF-8605275—).

From VGB special meeting on Yugoslavia; Bled, Yugoslavia (14 May 1986).

For the first time, a pressurized FBC steam generator with a thermal output of 40 MW was built and commissioned in the thermal power plant of the Aachen Technical University. Various aspects resulting in the construction and corresponding design of the system are explained. Switching diagrams are used to describe both atmospheric and pressurized operations and their control. Experiences gained with the commissioning of individual components are described. (HAG).

40783 (INIS-mf—10706, pp 1-7) **Determination of the residual service life of power plant components and its prolongation by repair and maintenance and by inspections.** Schuhmann, H. 1986. (In German). NTIS (US Sales Only), PC A16/MF A01. File Number DE87752788. (CONF-8605275—).

From VGB special meeting on Yugoslavia; Bled, Yugoslavia (14 May 1986).

The service life of power plant components is determined by their design and their use. This paper goes to show that good and regular maintenance/repair and inspection as well as accurate matching of operating mode will result in a prolongation of component service life. The paper describes in detail design, operating, maintenance/repair, and inspection. (HAG).

40784 (INIS-mf—10706, pp 1-16) **Influence of time on stress-induced crack corrosions in turbine rotors.** Majcen, M.; Majcen, A. 1986. (In German). NTIS (US Sales Only), PC A16/MF A01. File Number DE87752788. (CONF-8605275—).

From VGB special meeting on Yugoslavia; Bled, Yugoslavia (14 May 1986).

The authors deal with the service life of steam turbine rotors, while focussing on the study of stress-induced crack corrosion at steam turbine parts. Statistical data on executed inspections and tests are presented. The development and application of nondestructive testing methods are commented on and the assessment of crack formation and crack propagation trend is described. (HAG).

40785 **(PB—87-187142/XAB) Study of saline water use at the Etiwanda Generating Station. Final report.** Laughlin, J.K. (Bureau of Reclamation, Denver, CO (USA). Engineering and Research Center). 16 Mar 1987. 89p. NTIS, PC A05/MF A01.

The report presents the results of a study to evaluate water treatment process options for the use of Palo Verde Irrigation Outfall Drain as a major water supply for a hypothetical coal-fired powerplant located in the Mojave Desert between Blythe, California, and Las Vegas, Nevada. The study was done in conjunction with a field test of ion exchange softening technology conducted at the Etiwanda Generating Station near San Bernardino, California. Data from the field-test program were used to support the design and cost evaluations of ion-exchange softening technology in the study. Sidestream lime/soda softening was the most cost-effective process option for treating Palo Verde Irrigation Outfall Drain water quality. Ion-exchange softening technology, using cooling tower blowdown for regeneration appears to be technically viable based on short-term testing, and is likely to be competitive in cost for waters high in hardness, high in sodium, and low in silica.

40786 **State of the art of 12Cr rotor materials.** Newhouse, D.L. *Materials and Components in Fossil Energy Applications;* No. 68, 1-3(1 Jun 1987).

Large steam turbine rotors of 12Cr (12 weight percent chromium) steels have been produced and used in high-pressure (HP) and intermediate pressure (IP) steam turbines operating at high temperatures since about 1955 in Europe, about 1960 in the US, and more recently in Japan. The excellent combination of strength, ductility and toughness, and good experience with 12Cr HP/IP rotors for steam temperatures of 566°C and below have made this material a prime candidate for application in improved steam plants in which a steam temperature of 593°C and possibly higher is contemplated. A survey was conducted for the Electric Power Research Institute (EPRI) to provide an assessment of the present state of the art with respect to rotor size, quality, and alloy properties. The main objectives and some of the results are discussed. 1 reference, 1 table.

40787 **In-service monitoring of wear in boiler components by surface layer activation.** Milder, F.L.; Farr, M.R. *Materials and Components in Fossil Energy Applications;* No. 68, 6-8(1 Jun 1987).

Accurate measurements of component wear in service are important for assessment of the component lifetimes and for materials development. A diagnostic method known as the radionuclide marker technique offers promise of providing on-line measurement of wear in various components in which such monitoring was hitherto very difficult and expensive, or impossible. This technique involves activation of a spot on a surface by exposing it to a high energy ion beam to make it slightly radioactive. The resultant gamma radiation is monitored from outside the operating system, and the decrease in activity serves as a measure of the wear occurring on the surface. The radioactivity generated is about 3 orders of magnitude less than that for previous radioisotope techniques, and thus poses very little health hazard. 3 references, 5 figures, 1 table.

40788 **Approaches to reducing boiler tube failures.** Cohen, J.; Dooley, D.B. *Materials and Components in Fossil Energy Applications;* No. 68, 8-10(1 Jun 1987).

Boiler tube failures (BTF) accounted for a loss of capacity of fossil fuel plants in the US in 1985 of about 6%, resulting in an annual cost to the utilities industry of more than 5 billion dollars. BTF is the largest single cause of disruption of the availability of power plants and is the focus of a significant research effort by the Coal Combustion Systems Division of the Electric Power Research Institute (EPRI). The problem of boiler tube failure arises inevitably from the complexity and stresses in the environment of the fossil fuel plant. A typical boiler in these plants may contain 483 km or more of steel tubing, all of which is subjected to internal attack by impurities in the water or steam and external corrosion by combustion gases and erosion by particular bombardment. In addition,

tubes are vulnerable to fatigue from both the vibration of the operating boiler and cyclic changes in temperature. Research has shown, however, that a large number of boiler tube failures in the US are repeat events that could be prevented through improvements in boiler operation and maintenance. Of the 22 BTF mechanisms that have been identified, only two require further research to determine the basic causes. These are corrosion fatigue failures that begin on the water side of waterwall and economizer tubing, and circumferential waterwall cracking that begins on the fire side of supercritical units. Guidelines for investigating and correcting BTF are presented briefly. 3 references.

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REFER ALSO TO CITATION(S) 40360, 40361, 40362, 40363, 40364, 40365, 40366, 40367, 40368, 40369, 40370, 40371, 40372, 40373, 40374, 40375, 40376, 40377, 40378, 40379, 40380, 40381, 40382, 40383, 40384, 40385, 40386, 40387, 40388, 40389, 40390, 40391, 40392, 40393, 40394, 42261

40789 **(DOE/OR/21400—H3) Utility FGD [flue gas desulfurization] survey, January-December 1985: Project summary.** Melia, M.T.; McKibben, R.S.; Jones, F.M. (PEI Associates, Inc., Cincinnati, OH (USA)). Apr 1987. Contract AC05-84OR21400. 29p. NTIS, PC A03. File Number DE87012918.

The Utility FGD Survey report, which is generated by a computerized data base management system, represents a survey of operational and planned domestic utility flue gas desulfurization (FGD) systems. It summarizes information contributed by the utility industry, system and equipment suppliers, system designers, research organizations, and regulatory agencies. The data cover system design, fuel characteristics, operating history, and actual system performance. Also included is a unit-by-unit discussion of problems and solutions associated with the boilers, scrubbers, and FGD systems. The development status (operational, under construction, or in the planning stages), system supplier, process, waste disposal practice, and regulatory class are tabulated alphabetically by utility company. Simplified process flow diagrams of FGD systems, definitions, and a glossary of terms are attached to the report. Current data for domestic FGD systems show 135 systems in operation, 15 systems under construction, and 56 systems planned. The current total FGD-controlled capacity in the United States is 57,899 MW.

40790 (INIS-mf—10706, pp 1-20) **Pollution control and its cost in power plant engineering.** Marnet, C. (Stadtwerke Duesseldorf A.G., Germany, F.R.). 1986. (In German). NTIS (US Sales Only), PC A16/MF A01. File Number DE87752788. (CONF-8605275—).

From VGB special meeting on Yugoslavia; Bled, Yugoslavia (14 May 1986).

In power plant engineering, pollution control does not only comprise desulphurization and denitrification but also dust removal, noise abatement, waste-heat reduction, radiation protection, effluent and waste treatment and, last but not least, the integration of plants into scenic landscapes. The author deals with the development of dust emissions and with the emissions of major gaseous pollutants from thermal power plants. In addition, he describes the impact of the Federal German Large-Scale Firing Installation Regulation on air pollution control as well as various technologies available for flue gas desulphurization and denitrification. (HAG).

40791 (INIS-mf—10706, pp 1-12) **Pollution control problems in Yugoslavia.** Paradiz, B. (Elektroinstitut Milan Vidmar, Ljubljana, Yugoslavia). 1986. (In German). NTIS (US Sales Only), PC A16/MF A01. File Number DE87752788. (CONF-8605275—).

From VGB special meeting on Yugoslavia; Bled, Yugoslavia (14 May 1986).

The author describes the pollution situation of air and water in Yugoslavia, while focussing on air pollution originating from thermal power plants with special reference to specific conditions of weather and topography. In addition, correlations between inversion layers, high levels of sulphur dioxide concentrations and forest damage are commented on and various measures for the reduction of pollutant emissions are discussed. In conclusion, he presents the pollution control programme of the Slovene thermal power plants. (HAG).

40792 (INIS-mf—10706, pp 1-38) **Operating experience with and new developments of dry-additive flue gas desulphurization.** Schroefelbauer, H. 1986. (In German). NTIS (US Sales Only), PC A16/MF A01. File Number DE87752788. (CONF-8605275—).

From VGB special meeting on Yugoslavia; Bled, Yugoslavia (14 May 1986).

The author describes the limestone-additive process for flue gas desulphurization in a lignite-fuelled power plant. He presents the process and major parameters, operating experience gained with a 330 MW unit, plant structure, initial operating experience and cost of the additive method. The development of the dry additive process involving sodium bicarbonate for simultaneous removal of sulphur dioxide and dust is discussed and the combination of limestone/dry-additive process with sodium bicarbonate is studied for its profitability.

40793 **Some effects of improvements in power plant emission control on materials and component selection and performance.** *Materials and Components in Fossil Energy Applications;* No. 68, 3-6(1 Jun 1987).

Requirements for control of sulfur and nitrogen oxide emissions from power plant boilers have resulted in continued improvements in existing equipment and new designs aimed at better control and/or cost effectiveness. Modifications necessary to accommodate these systems in existing steam boilers introduce further complications to the already difficult fireside environment, in which heat transfer tubes are required to survive for 20 to 30 years. A few examples of the materials and components considerations involved with such improvements are outlined. 4 references, 2 figures.

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40794 (EPRI-EL—5143-SR, pp 1.1-1.3) **Technical Requirements: dielectric liquids.** Rouse, T.O. (General Electric Co., Pittsfield, MA). Apr 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920390.

In Proceedings: Workshop on substitute insulation for polychlorinated biphenyls.

The insulation system in modern transformers is made up of several components - both solid and liquid. The solids are expected to resist the uncontrolled transfer of electrical charge (breakdown under voltage stress). Often they provide dimensional stability and physical support - and do this over a range of temperatures and for many years. Copper or aluminum conductors are coated with carefully cured polymeric enamels and wraps of cellulose paper (turn) insulation. Sheets of thick cellulosic paper (layer) insulation are interleaved in the coil wound from the conductor. Pressboard and high density wood, sometimes impregnated with polymer filler, are often used for structural support. Liquids are also expected to resist electrical breakdown, both alone and when filling voids in and around porous solids. Liquids also remove heat from the hottest spots in the transformer to reduce the rate of degradation of the in-place solids. Liquids too must resist reduction in quality during long service life and they should not leave behind a trail of debris from aging. (Dry transformers insulated with air, and gas insulated transformers insulated with air, and gas insulated with air, and gas insulated transformers are not discussed here.) The majority of transformers manufactured over the past ninety years have been filled with mineral oils refined from petroleum crudes. The economics of the situation say that this will continue into the future. The need for alternate liquids will continue to be in specialized applications such as high fire risk installations. Some of the factors that should be considered in using other liquids as dielectrics are examined.

40795 (EPRI-EL—5143-SR, pp 1.2.1-1.2.4) **Code requirements for transformer vault design.** West, B.W. (West & Hansen Engineers, Inc., Seal Beach, CA). Apr 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920390.

In Proceedings: Workshop on substitute insulation for polychlorinated biphenyls.

Design of high voltage (π600 V) transformer installations is governed by a set of codes intended to insure a minimum level of electrical safety. Fire, electrical, mechanical and building codes all contain sections relevant to transformer installation. The codes have been compiled over a period of years by committees comprised of experienced engineers in each field. Non-profit organizations publish the codes, and periodic up-dates, for use by governing authorities and practicing designers.

40796 (EPRI-EL—5143-SR, pp 1.3.1-1.3.4) **Looking into the crystal ball: will EPA be regulating PCB substitute fluids in the future?.** Keehner, D.M. Apr 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920390.

In Proceedings: Workshop on substitute insulation for polychlorinated biphenyls.

Over the past few years, utilities and other PCB equipment owners have both voluntarily and not so voluntarily initiated PCB equipment phase-out programs. These equipment owners are concerned, and understandably so, that the dielectric fluid that they choose to replace the PCBs will not be subsequently chosen by EPA at some future data for regulatory controls. It is difficult to say whether substitute dielectric fluids as a class will ever be regulated by EPA or whether particular chemicals that are used as substitute fluids will be regulated but, accordingly it is recommended that when choosing substitute fluids and substitute equipment, that collective experience with PCBs be reflected and not ignore the reasons why PCBs have been the subject of extensive environmental regulation.

40797 (EPRI-EL—5143-SR, pp 1.4.1-1.4.5) **Pyrolysis and combustion of PCB substitutes: a state-of-the-art review.** Marsh, J.R.R. Apr 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920390.

In Proceedings: Workshop on substitute insulation for polychlorinated biphenyls.

Since 1979, the manufacture and use of PCBs have been restricted by law. A number of chemicals have been and are being considered for use as PCB substitutes in electrical applications. Something that must be considered is whether any of these substitutes would yield comparable products of incomplete combustion in the event of a fire or explosion. To date, with a very few exceptions, little research has been conducted to determine whether partial combustion or pyrolysis of these substitute compounds will yield the same types of highly toxic or carcinogenic compounds. The PCB substitutes included in this review were phthlate esters, benzylneocaprate, polydimethyl siloxane, chlorobenzenes, methylated diphenylethane, phenylxylylethane, butylated monochlorodiphenylether, alkyl biphenyls, paraffinic, hydrocarbons, perchloroethylene, chlorofluorocarbons, sulfur hexafluoride, epoxy resins, and polyvinyl chloride. The PICs of primary concern are the chlorinated dioxins, dibenzofurans, and polycyclic aromatic hydrocarbons. Only the chlorobenzenes and polyvinyl chloride of the substitutes reviewed have actually been shown in laboratory or field tests to produce these types of compounds. However, several others are suspected to produce toxic trace PICs. The pyrolysis and combustion of these PCB substitutes are discussed.

40798 (EPRI-EL—5143-SR, pp 1.5.1-1.5.4) **Replacement of PCB network transformers by PG & E.** Milliken, A.R. (Pacific Gas & Electric Co., San Francisco, CA). Apr 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920390.

In Proceedings: Workshop on substitute insulation for polychlorinated biphenyls.

Faced with the necessity of selecting a different fluid for network transformers when Monsanto stopped producing askarel in 1977, PG & E decided to go with mineral oil for new installations. This decision was influenced by an architectural trend away from mid-floor and roof-top transformer installations back to service from single, below-grade vaults. Concurrent with the decision to use mineral oil, the vault design was changed to incorporate a fire barrier between pairs of transformers. Attention was also given to the routing and fire-proofing of HV cables. This was the pattern of network vault installations until the #1 Market Plaza incident. Silicon was selected as the fluid for general use as a PCB substitute. Results of this decision are discussed.

40799 (EPRI-EL—5143-SR, pp 2.1.1-2.1.8) **Fluorocarbon 113 as a transformer dielectric.** Schultz, D.L. (E.I. du Pont de Nemours, Inc.). Apr 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920390.

In Proceedings: Workshop on substitute insulation for polychlorinated biphenyls.

Fluorocarbons relative to other transformer dielectrics, such as the hydrocarbon oils or chlorinated organics such as perchloroethylene, are discussed. The carbon-fluorine compounds often also contain chlorine and are frequently called chlorinated-fluorinated compounds, or CFC's. Chemically, 113 is 1.1.2 trichloro 1.2.2 trifluoroethane, or trichlorotrifluoroethane. A manufacturing method for the CFC's is often the substitution of all or part of the chlorine of specific chlorinated organics. This fluorine substitution substantially improves the toxicity, stability and compatibility of the compound, and all are non-flammable. As a transformer dielectric, CFC-113 is the most environmentally acceptable of the possible candidates. The feasibility of using CFC-113 as a PCB replacement is discussed.

40800 (EPRI-EL—5143-SR, pp 2.2.1-2.2.4) **Dry transformers.** Veverka, E.F. (McGraw-Edison Power Systems, Franksville, WI). Apr 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920390.

In Proceedings: Workshop on substitute insulation for polychlorinated biphenyls.

Oil-filled transformers are subject to catastrophic failure when arcing is initiated by an internal fault or by the abnormal operation of an internal oil-immersed primary fuse. The arc decomposes the oil creating both internal pressure and an explosive gas mixture within the tank. The result of the pressure build-up, often coupled with an explosion, can blow out bushings, blow off the cover, and even rupture the tank. The result is a significant hazard to personnel and the surroundings. If the dielectric fluid is a PCB fluid or PCB contaminated oil, the resultant arc products require very extensive/expensive clean-up. The application of dry type transformers avoids the problems of explosion, fire, and contamination inherent to failed oil insulated transformers. However, their application is restricted by: limited thermal overload capability based on air cooling of insulation/conductor system; limited dielectric capability of dry insulation/air insulated systems; and larger size/cost due to thermal and dielectric shortcomings of the insulation system. The feasibility of dry type transformers is discussed.

40801 (EPRI-EL—5143-SR, pp 2.3.1-2.3.4) **Risk assessment of Formel-NF transformer fluid.** Slinn, D.S.L. (I.S.C. Chemicals Ltd., Avonmouth, England). Apr 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920390.

In Proceedings: Workshop on substitute insulation for polychlorinated biphenyls.

All transformer fluids are chemicals and their safety should be assessed across the whole environmental and use spectrum. The risks involved during the use of Formel-NF are discussed and it is concluded that these are acceptable.

40802 (EPRI-EL—5143-SR, pp 2.4.1-2.4.6) **Midel 7131: toxicological, environmental and fire aspects.** Hegeman, G. (BASF Lacke + Farben AG, Hamburg, West Germany). Apr 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920390.

In Proceedings: Workshop on substitute insulation for polychlorinated biphenyls.

Midel 7131 is a blend of pentaerythritol-fatty acid esters developed for use as an insulating and cooling liquid in transformers. Up till now experience over 8 years shows that the fluid remains stable in service. For the introduction of Midel 7131 into Germany extensive toxicological tests were not mandatory. However, the German Environmental Agency decided that it was not unreasonable to expect a material being offered as a substitute for PCB's to undergo additional toxicity, environmental and fire testing. The main toxicological data for Midel 7131 are shown. A 90-day feed-

ing test to determine the subchronic toxicity of Midel 7131 has been finished and a preliminary report shall be available in January 1987.

40803 (EPRI-EL—5143-SR, pp 2.5.1-2.5.5) **Polyalphaolefins as electric insulating fluids.** Robson, R.J. (Chevron Research Co. Richmond, CA). Apr 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920390.

In Proceedings: Workshop on substitute insulation for polychlorinated biphenyls.

Most electrical insulating fluids for transformers and related electrical equipment are made from naphthenic petroleum crude oil. Recently, some fluids have been made from paraffinic crudes. Polyalphaolefins (PAOs) have performance advantages over petroleum-based oils. In addition, higher viscosity PAOs are excellent alternatives to polychlorinated biphenyls (PCBs). The use of PAOs are electrical insulating fluids is explored in two ways, i.e., PAOs as replacements for mineral oils and PAOs as replacements for PCBs.

40804 (EPRI-EL—5143-SR, pp 2.6.1-2.6.5) **Health, environmental, safety, performance and economic analysis of TREmp fluid: the first decade.** McShane, C.P. (RTE Corp., Waukesha, WI). Apr 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920390.

In Proceedings: Workshop on substitute insulation for polychlorinated biphenyls.

There are four key areas of RTE's focus regarding askarel substitute fluids. These are: performance, health and environment, fire safety, and cost. The feasibility of using RTEmp fluid as a replacement for PCBs in electric transformers is discussed.

40805 (EPRI-EL—5143-SR, pp 2.7.1-2.7.10) **Silicone transformer fluid: the choice for safety and performance.** McClintick, B. Apr 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920390.

In Proceedings: Workshop on substitute insulation for polychlorinated biphenyls.

Liquid filled transformers were developed over 75 years ago and remain the preferred choice for medium and large power units. In recent years, technology has increased to differentiate the various fluids by assessing not only electrical and physical properties but fire and toxicity properties as well. The motive behind the testing is to develop acceptable dielectric materials which perform well in service, are cost effective, and represent the lowest safety hazard potential. Long before the discovery in the early 1970's of the possible hazardous effects of PCB's in the environment, Dow Corning had investigated silicone fluid as a dielectric coolant. Prior to and after its introduction as a transformer fluid in 1974, numerous studies have documented many of the characteristics of silicone liquid. The basic performance, environmental, toxicological and fire safety testing aspects of silicone transformer fluid are reviewed.

40806 (EPRI-EL—5143-SR, pp 2.8.1-2.8.5) **Tetrachloroethylene: the safe and inexpensive substitute transformer insulation.** Siemak, J.B. (Dow Chemicals USA, Walnut Creek, CA). Apr 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920390.

In Proceedings: Workshop on substitute insulation for polychlorinated biphenyls.

Tetrachloroethylene has been used safely in industry for over 50 years. This fluid's physical and chemical properties make it a very good choice for use as a substitute for transformer insulation. The high boiling point, low viscosity, high dielectric strength and good heat transfer ability of this fluid all contribute to efficient operation in a sealed transformer. The ability to remain nonflammable under arcing conditions without producing any persistent harmful by-products sets this fluid apart from other insulation fluids. Environmental concerns for use of this fluid are low, since it does not bioaccumulate, cause any significant ozone depletion nor would this use contribute significant pollution in water or air. Health concerns about this fluid are minimal as tetrachloroethylene has tested negative on mutagenic or teratogenic responses and no human carcinogenicity has been demonstrated. Also, since this fluid is in a sealed unit, human exposure is highly unlikely. All this coupled with a low cost per gallon, as compared to other available nonflammable insulation fluids, makes this fluid the choice for use as a transformer insulation.

40807 (EPRI-EL—5143-SR, pp 3.1.1-3.1.4) **Screening for pyrolysis and combustion products of selected dielectric fluids.** Erickson, M.D.; Meeks, S.C.; Sack, T.M. (Midwest Research Institute, Kansas City, MO). Apr 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920390.

In Proceedings: Workshop on substitute insulation for polychlorinated biphenyls.

A number of fires and other thermal incidents involving PCB-containing electrical equipment have been reported in the US and Europe in recent years. In addition to dispersing the PCBs, these incidents have also formed more toxic by-products, including polychlorinated dibenzofurans (PCDFs), which cause further contamination. These incidents have been expensive, prompted regulatory action by EPA, and accelerated the phase-out of PCBs in electrical equipment. A variety of thermally stable fluids are being used in the specialty applications where PCBs have previously been used. These include alkyl biphenyls (e.g., Wemcol) and other alkyl aromatics, paraffinic hydrocarbons (e.g., RTEmp), esters (e.g., benzyl neocaprate), polydimethylsiloxanes, chlorobenzenes (e.g., Electrochem FR-15), tetrachloroethylene (e.g., Wecosol), chlorofluorocarbon/chlorocarbon mixtures (e.g., Formel NF). The objective of this study is to provide utilities with information on potential toxic hazards from thermal degradation products of PCB-substitute dielectric fluids, along with other materials used in transformers, capacitors, switch gear cables, and other equipment. The dielectric fluids which have been combusted and pyrolyzed as part of the overall program to evaluate utility materials are discussed.

40808 (EPRI-EL—5143-SR, pp 3.2.1-3.2.2) **Pyrolysis and combustion of chlororganics in dielectric fluids.** Eadon, G. (New York State Dept. of Health, Albany). Apr 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920390.

In Proceedings: Workshop on substitute insulation for polychlorinated biphenyls.

Numerous laboratory simulations and several real world incidents have demonstrated that, under certain conditions, heating of concentrated solutions of polychlorinated biphenyls (PCBs), or tri- and tetrachlorobenzenes (TCBs) can produce significant concentrations of polychlorinated dibenzodioxins (PCDDs) and/or polychlorinated dibenzofurans (PCDFs). However, at the outset of this EPRI-supported project, little was known about the thermal behavior of these compounds when diluted to the 5000-50 ppm concentration range with various retrofill fluids or askarel substitutes. Two heating regimens were selected for study with the goal of choosing conditions that were distinct from each other as well as those used by earlier and contemporary investigators and that might bear some similarity to potential real world events. These experiment are discussed.

40809 (EPRI-EL—5143-SR, pp 3.3.1-3.3.4) **Pyrolysis and combustion of substitute aromatic capacitor fluids.** Mazer, S.; Stalter, J. (Univ. of Dayton Research Institute, OH). Apr 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920390.

In Proceedings: Workshop on substitute insulation for polychlorinated biphenyls.

Under EPRI Contract No. RP-2028-16, researchers at the University of Dayton Research Institute have been investigating combustion and pyrolysis products from a wide variety of utility materials. These include polyethylene and PVC cable materials, Kraft paper, phenolic resins, and many others. As part of this program, organic thermal decomposition products have been identified for five commercially-available replacement capacitor fluids. These fluids were formulated from combinations of n-propylbiphenyl, isopropylbiphenyl, phenylxylylethane, and dixylylethane. Results of this research are presented.

40810 (EPRI-EL—5143-SR, pp 3.4.1-3.4.8) **Risks involved with PCB substitutes.** des Rosiers, P.E. (Environmental Protection Agency, Washington, DC). Apr 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920390.

In Proceedings: Workshop on substitute insulation for polychlorinated biphenyls.

PCBs, CDDs, and CDFs are subject to new regulations promulgated under the Toxic Substances Control Act and the Resource Conservation and Recovery Act. The finding of CDDs and CDFs in PCBs, PCB-contaminated materials and soot generated from fires could restrict disposal options. A review of major fire incidents in the US indicates that CDDs have been found (at ppm levels) only in the Binghamton, New York, transformer fire incident and laboratory combustion studies further support formation of CDFs from PCBs and CDDs from chlorobenzenes. No CDDS were found in analyses of fluids from transformers involved in fire incidents. CDFs do not appear to increase in PCB askarel fluids from normal usage in electrical equipment. Comparative tests performed in France indicate extremely high soot/particulate levels generated from silicon transformer fires; a commercial mixture of tetrachlorotoluenes/trichlorobenzenes was found to produce less than one-hundredth as much.

40811 **(EPRI-EL—5258) Fusing research on personnel grounding cables: Final report.** Reichman, J.; Kuffel, J.; Vainberg, M. (Ontario Hydro, Toronto (Canada). Research Div.; Electric Power Research Inst., Palo Alto, CA (USA)). Jul 1987. 153p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920499.

This report describes the theoretical development and experimental verification of a computer program for generating high-current short-duration failure characteristics of personnel grounding cables. The computer model is based on an approach which relates the temperature rise of a cable to the time integral of current density. The analytical derivation upon which the model is based allows for prediction of cable failure characteristics not only for symmetrical, but also for asymmetrical currents. To generate a statistically valid data base for checking the accuracy of the model, several hundred tests were carried out on cables varying in size from 1/0 to 250 MCM with current magnitudes ranging between 17 kA and 80 kA. Analysis of the data obtained from these tests shows that the failure characteristics predicted using the model agree well with those determined experimentally. 8 refs., 29 figs., 16 tabs.

40812 **(EPRI-EL—5262) Partial combustion of electrical insulation fluids: Final report.** Claiborne, C.C. (Westinghouse Electric Corp., Sharon, PA (USA). Materials Manufacturing Technology Dept.; Electric Power Research Inst., Palo Alto, CA (USA)). Jul 1987. 67p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920535.

Recurring fire incidents involving transformers have led to a desire to acquire information about the combustion products that may be generated not only in situations of complete combustion, but also in incidents when limited oxygen is present and combustion is incomplete or partial. This report details some results from investigations designed to identify the products of incomplete combustion of five types of dielectric fluids commonly used in transformers, as alternatives to askarels. These fluids are tetrachloroethylene, trichlorotrifluoroethane, polydimethylsiloxane (silicone fluid), mineral oil, and a high temperature hydrocarbon. The investigation of these fluids was begun with a theoretical study of the thermodynamic equilibrium over a range of temperatures and pressures. The experimental program was carried out in two separate studies, one which involved heating the fluid from room temperature to 1000°C and another which used injection into a furnace that was preheated to 1000°C. The air level in each chamber was chosen to provide 70% and 30% of the oxygen for stoichiometric total combustion. None of the combustions produced detectable chlorinated or polycyclic aromatic hydrocarbon particulates. Detectable quantities of chlorine and hydrogen chloride were produced from tetrachloroethylene as well as a small amount of dichloroacetylene. Trichlorotrifluoroethane produced a number of fluorocarbon compounds as well as hydrogen fluoride. Silicone fluid produced substantial quantities of a solid material, believed to be silicon dioxide and like the two hydrocarbon fluids, produced several combustible hydrocarbon gases as well as carbon dioxide and carbon monoxide. 9 refs., 19 figs., 12 tabs.

40813 **(ORNL/Sub—85-00200/2) Electric field under EHV transmission lines: Theroretical analysis and statistical comparison and TVA measurements.** Simpson, T.L.; Brice, C.W. III. (South Carolina Univ., Columbia (USA). Coll. of Engineering). Jun 1987. Contract AC05-84OR21400. 290p. NTIS, PC A13/MF A01; GPO Dep. File Number DE87013354.

Electric fields under EHV transmission lines are analyzed and compared with TVA measurements. Three electric field models are developed: the level ground plane (LGP) model, the tilted ground plane (TGP) model, and the charge moment method (CMM). These theoretical models are implemented for computer analysis and statistical comparison with the available data. The effects of terrain irregularity and tree shading are progressively incorporated in the hierarchy of models yielding a corresponding reduction in the residual error. 18 refs., 28 figs., 12 tabs.

21 NUCLEAR POWER PLANTS

REFER ALSO TO CITATION(S) 40915, 41011, 41013, 41090, 41543, 41645

40814 **(EPRI-EA—5052) Trends in power plant construction lead times: Survey of project analysis and results.** Bauman, D.; Morris, P.; Radlouer, M.; Rice, T. (Applied Decision Analysis, Inc., Menlo Park, CA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). 1987. 53p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920284.

This study focused on the problem of excessively long construction lead times and unexpected delays encountered by many nuclear power plant constructors in the recent past. The topics investigated are: current industry status; implications for planning and policy; long term planning; regulations; lead time; and cost growth. (FI)

40815 **(INIS-mf—9937) Order of 10 August 1984 on design quality, construction and operation of large nuclear installations.** (International Atomic Energy Agency, Vienna (Austria)). 22 Sep 1984. 7p. (In French). NTIS (US Sales Only), PC A02/MF A01. File Number DE87780138.

This Order contains provisions with regard to operators of large nuclear installations. They must ensure that the quality of the structures, equipment and operating conditions are commensurate with the importance of their functions from the viewpoint of the safety of the installation concerned. Operators must also exercise control over all suppliers of equipment and services, as they are answerable to the Central Service for the Safety of Nuclear Installations for quality assurance. The Order prescribes the general principles to be applied for organizing quality control. A programmed quality assurance system must be put in place and entered in a file. Such assurance must also cover studies on activities related to the safety of large nuclear installations.

2101 Power Reactors, Non-breeding, Light-water Moderated, Boiling Water Cooled

REFER ALSO TO CITATION(S) 40838, 40839, 40840, 40841, 40857, 40886, 40887, 40892, 40894, 40895, 40896, 40982, 40989, 40990, 41002, 41008, 41009, 41012, 41028, 41029, 41035, 41043, 41044, 41046, 41051, 41054, 41055, 41056, 41057, 41058, 41059, 41060, 41061, 41062, 41072, 41074, 41076, 41338

40816 **(CONF-870816—26) Condensation of steam on the underside of a horizontal surface in the presence of air and helium.** Stein, R.P.; Cho, D.H.; Lambert, G.A. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 8p. NTIS, PC A02. File Number DE87011384.

From 24. national heat transfer conference and exhibition; Pittsburgh, PA, USA (9 Aug 1987).

Experiments and data analysis for the condensation of steam on the underside of a horizontal surface in a closed vessel are described. Previously reported results for film condensation with air as a noncondensable gas are reviewed and compared with new data with helium as the noncondensable in the same apparatus. Observations, including photographs of the condensate configurations, relat-

ed to the occurrence of dropwise condensation are also discussed. It is noted that data reproducibility over long periods of time were possible only with film condensation and that with dropwise condensation condensing surface temperatures exhibited large nonuniformities and random fluctuations with time. The well known mass transfer calculational model for accounting for the presence of noncondensable gases had been shown previously to be successful with air. The same model when applied to the helium data was not successful except for small gas contents. It appears that the suppression of convection that would be expected to occur with the less dense gas is counteracted by convection induced by fog or mist formation.

40817 (EPRI-CS/NP—3016-Vol.4B, pp 2.35-2.51) **Boiling water reactor modeling capabilities of MMS-02.** May, R.S.; Abdollahian, D.A.; Elias, E.; Shak, D.P. (S. Levy Inc., Campbell, CA). Apr 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920392. (CONF-8409396—Vol.4B).

From Workshop on Modular Modeling System (MMS); New Orleans, LA, USA (26 Sep 1984).

During the development period for the Modular Modeling System (MMS) library modules, the Boiling Water Reactor (BWR) has been the last major component to be addressed. The BWRX module includes models of the reactor core, reactor vessel, and recirculation loop. A pre-release version was made available for utility use in September 1983. Since that time a number of changes have been incorporated in BWRX to (1) improve running time for most transient events of interest, (2) extend its capability to include certain events of interest in reactor safety analysis, and (3) incorporate a variety of improvements to the module interfaces and user input formats. The purposes of this study were to briefly review the module structure and physical models, to point the differences between the MMS-02 BWRX module and the BWRX version previously available in the TESTREV1 library, to provide guidelines for choosing among the various user options, and to present some representative results.

40818 (EPRI-CS/NP—3016-Vol.4B, pp 3.13-3.31) **Drift flux formulation of a boiling water reactor channel with subcooled boiling.** Elias, E.E.; Shak, D.P.; May, R.S. (S. Levy Inc., Campbell, CA). Apr 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920392. (CONF-8409396—Vol.4B).

From Workshop on Modular Modeling System (MMS); New Orleans, LA, USA (26 Sep 1984).

The channel formulation used in the BWR module of the Modular Modeling System MMS-02 is presented. The purpose of channel model is to accurately predict the transient response of the enthalpy void and flow rate. Accurate prediction of the two-phase enthalpy, and void fraction distributions along the channel is important since they are key input parameters to the neutronic model, and have direct effect on the core and overall reactor response. In order to model the channel response correctly, the physical phenomena had to be realistically represented. The model accounts for subcooled boiling and slip through the use of an empirical subcooled void-quality model. Simplifying assumptions are made so that only one differential equation, the energy equation, is integrated along the channel. A consistent use of semi-empirical correlations enables a complete representation of the channel flow and void fraction with the bulk enthalpy as the only state variable. The differential equation and the constitutive relations of this two-phase flow model are presented. Several numerical examples are given, and finally, come conclusions are presented.

40819 (EPRI-CS/NP—3016-Vol.4B, pp 7.77-7.89) **MMS modeling of the FERMI-2 plant.** Arndt, C.R. (Detroit Edison, MI). Apr 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920392. (CONF-8409396—Vol.4B).

From Workshop on Modular Modeling System (MMS); New Orleans, LA, USA (26 Sep 1984).

Detroit Edison's Fermi-2 BWR and Balance-of-Plant (BOP) was modeled using MMS, the Modular Modeling System. The Company previously used RETRAN for the reactor and BOP, but since RETRAN was developed primarily for reactor transients, it was awkward to extend its application. MMS, which is semi-preformulated, offered the promise of being more user-friendly. As a member of the first MMS users group, the feedwater-drains portion of the plant was modeled. Since then MMS has been applied to the turbine - reheater portion and the reactor-steam line section including the controls. Although the three portions were successfully modeled, initialized, and run individually; attempts to run the combined model (208 states) were limited by computer structure. Therefore, size reduction of the feedwater strings and of the BWR were necessary. At its present size of 120 states, the plant model (without the BWR module) has been executed for a turbine trip transient. Results from this work, which was more expensive and time-consuming than expected, will be presented. The impressions of MMS after this sobering experience along with details of the model are described. Also presented are some comparisons with RETRAN and recommendations for future systems modelers.

40820 (EPRI-CS/NP—3016-Vol.4B, pp 7.123-7.135) **Application of EASY5 and MMS modules to BWR controller design.** Carmichael, L.A.; Rayes, L.; Yasutake, T. (Science Applications International Corp., Los Altos, CA). Apr 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920392. (CONF-8409396—Vol.4B).

From Workshop on Modular Modeling System (MMS); New Orleans, LA, USA (26 Sep 1984).

The application of EPRI's MMS Library and BCS' EASY5 simulation language to the design of a digital feedwater control system for the Monticello Boiling Water Nuclear Power Plant is discussed. In order to first design and then verify the digital feedwater controller algorithms, a digital simulation model of the Monticello plant was constructed using a combination of custom designed modules, existing MMS two-phase library modules, and standard modules available in the EASY5 library. Details of the process models, namely the BWR nuclear steam supply system, the steamline piping, and the feedwater piping are described in a companion paper. Details of the models for the existing BWR turbine pressure inlet pressure control and recirculation flow control system are described. These models are required to be operational during the transient analysis portion of the feedwater controller design verification, since they interact strongly with the reactor steam flow and water level. The design of the digital feedwater flow control loop is described. Its design is of particular interest because it requires consideration of control loop interaction and is, therefore, a simple example of multivariable non-interacting control design.

40821 (EPRI-CS/NP—3016-Vol.4B, pp 7.161-7.222) **EASY 5 BWR simulation model for digital feedwater control design.** Hashemi, A.; Lin, C.S.; Carmichael, L.A.; Lee, S. (Science Applications International Corp., Los Altos, CA). Apr 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920392. (CONF-8409396—Vol.4B).

From Workshop on Modular Modeling System (MMS); New Orleans, LA, USA (26 Sep 1984).

The development of a BWR simulation model in support of a program to design and evaluate the digital feedwater control system for the Monticello Boiling Water Reactor (BWR) is described. This model was developed in the EASY5 simulation language in conjunction with EPRI's Modular Modeling System (MMS) two-phase Library. The model consists of three main elements: the BWR reactor vessel module, the feedwater system model, and the steamline model. Transient results for the BWR vessel module and the feedwater system model are presented.

40822 (EPRI-CS/NP—3016-Vol.4B, pp 8.3-8.11) **MMS-EASE: a pre- and post-processor for the Modular Modeling System .** Long, A.B.; Bartells, P.S. (Expert-Ease Systems, Menlo Park, CA). Apr 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920392. (CONF-8409396—Vol.4B).

From Workshop on Modular Modeling System (MMS); New Orleans, LA, USA (26 Sep 1984).

The Modular Modeling System (MMS) is a computer code developed under contract to the Electric Power Research Institute to assist utility engineers with modeling the dynamic performance of fossil-fired and nuclear steam electric power plants. The MMS-

EASE pre- and post-processor which is being developed to run on an IBM-PC as a friendly and powerful interface between the engineer and the Modular Modeling System are described.

40823 (EPRI-CS/NP—3016-Vol.4B, pp 8.15-8.23) **Babcock & Wilcox STACSL integration options in ACSL.** Thompson, S.; Tuttle, P.G. Apr 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920392. (CONF-8409396—Vol.4B).

From Workshop on Modular Modeling System (MMS); New Orleans, LA, USA (26 Sep 1984).

The pertinent features of the Babcock & Wilcox ordinary differential equation solver STACSL which has been implemented in the ACSL Advanced Continuous Simulation Language are described. STACSL solves systems which have either a dense or a sparse Jacobian matrix. Root-finding techniques are incorporated in STACSL to efficiently solve problems with derivative discontinuities or other special events which must be detected and processed. Extensive diagnostics are also included in STACSL to assist in developing and debugging complex models. Each of these features is described and illustrated.

40824 (EPRI-CS/NP—3016-Vol.4B, pp 8.27-8.37) **Experience gained in running the EPRI MMS code with an in-house simulation language.** Weber, D.S. (Philadelphia Electric Co., PA). Apr 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920392. (CONF-8409396—Vol.4B).

From Workshop on Modular Modeling System (MMS); New Orleans, LA, USA (26 Sep 1984).

The EPRI Modular Modeling System (MMS) code represents a collection of component models and a steam/water properties package. This code has undergone extensive verification and validation testing. Currently, the code requires a commercially available simulation language to run. The Philadelphia Electric Company (PECO) has been modeling power plant systems for over the past sixteen years. As a result, an extensive number of models have been developed. In addition, an extensive amount of experience has been developed and gained using an in-house simulation language. The objective of this study was to explore the possibility of developing an MMS pre-processor which would allow the use of the MMS package with other simulation languages such as the PECO in-house simulation language.

40825 (EPRI-CS/NP—3016-Vol.4B, pp 8.41-8.45) **Future development of EASY5 for MMS applications.** Ummel, B.R. (Boeing Computer Services Co., Tukwila, WA). Apr 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920392. (CONF-8409396—Vol.4B).

From Workshop on Modular Modeling System (MMS); New Orleans, LA, USA (26 Sep 1984).

In response to needs identified during MMS validation testing, a number of enhancements were made to EASY5 specifically for MMS Applications. Changes in model building included improving the efficiency of the sorting algorithm by up to 50% for large models, improving the diagnostic messages printed when encountering implicit loops, and adding a MACRO DECLARATION capability which allows internal arrays for workspace to be automatically allocated. The EASY5 Steady State solver was enhanced to automatically freeze singular state variables and to enable validity error printout when the steady state solution is not physically meaningful. Because of the special nature of the numerical integration required for MMS models, BCS developed an algorithm called BCS Gear which runs up to 40% faster than Stiff Gear on large models, is synchronized for use with models simulating digital controllers, and gracefully terminates if the model detects an invalid operating condition. EASY5 is continuously being refined. Current EASY5 enhancement activity includes making EASY5 available on more computers (latest additions are the FPS-164 by Floating Point Systems and the Apollo desktop workstation by Apollo Computer), continued improvement in model building capability and efficiency for large models, and several new analysis capabilities, i.e., (1) fixed-step Runge-Kutta and user-supplied integration methods, (2) improved frequency response with power spectrum printout, and (3) a powerful combination time and frequency domain design method.

40826 (EPRI-CS/NP—3016-Vol.4B, pp 8.49-8.62) **MMS control system analysis using automated root-locus plot generation.** Hefler, J.W. (Bechtel Power Corp., San Francisco, CA). Apr 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920392. (CONF-8409396—Vol.4B).

From Workshop on Modular Modeling System (MMS); New Orleans, LA, USA (26 Sep 1984).

Use of the Modular Modeling System (MMS) for control systems improvement has been impeded by the need to plot eigenvalues manually. This problem has been solved by an automatic eigenvalue plotting routine. A practical procedure for control systems analysis based upon automatically generated root-locus plots has been developed using the Advanced Continuous Simulation Language (ACSL)-based version of the Modular Modeling System. Examples are given of typical ACSL run-time statements. Actual root-locus and time history plots are shown for simple models (4 state variables). More complex models are discussed. The plots show the control systems response before and after the determination of tuning parameters using the methods described.

40827 (EPRI-CS/NP—3016-Vol.4B, pp 8.77-8.84) **Commercialization of the modular modeling system.** Bartells, P.S. Apr 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920392. (CONF-8409396—Vol.4B).

From Workshop on Modular Modeling System (MMS); New Orleans, LA, USA (26 Sep 1984).

The Modular Modeling System (MMS) was developed by the Electric Power Research Institute (EPRI) to provide an efficient, economical, and user-friendly computer code for use in the analysis of the dynamic performance of nuclear and fossil power plants. The MMS has been under development since 1978 and is now ready for general release to the industry. To most effectively transfer the MSS technology on a worldwide basis, EPRI has licensed the Babcock & Wilcox Company (B & W) to act as the MMS code coordinator and commercial licensing agent. B & W is responsible for promoting the use of MMS and assisting users in the effective utilization of this new analysis tool. The history behind the commercialization of the MMS and the mechanism by which the MMS technology will be effectively transferred to provide for a self-sustaining and technically current analysis tool are outlined.

40828 **(EPRI-NP—4902-SR) Nondestructive Evaluation Program: Progress in 1986.** (Coe Corp., Sunnyvale, CA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jul 1987. 526p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920519.

The increasing cost of equipment for power generating plants and the potential increases in productivity and safety available through rapidly developing Nondestructive Evaluation (NDE) technology led EPRI to initiate a Nondestructive Evaluation Program in 1974. To date, the major focus has been on light water reactor inspection problems; however, increased application to other systems is now under way. This report presents a comprehensive review of the EPRI effort in the NDE area. Most of the report consists of contractor-supplied progress reports on each current project. An organizational plan of the program is presented in overview. In addition, organization from several viewpoints is presented, e.g., in-service inspection operators, R and D personnel, and utility representatives. The report summarizes significant progress made since the previous EPRI Special Report NP-4315-SR was issued in May 1986. Section 1 contains information about the program organization, and the sections that follow contain contractor-supplied progress reports of each current project. The progress reports are grouped by plant components - pipe, pressure vessel, steam generator and boiler tubes, and turbine. In addition, Part 6 is devoted to discussions of technology transfer.

40829 **(EPRI-NP—5193) Measurement of pH and corrosion potentials of tube alloys in solutions found in steam generators: Final report.** Hettiarachchi, S.; Lenhart, S.J.; Macdonald, D.D. (SRI International, Menlo Park, CA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). May 1987. 103p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920468.

Two of the most important parameters in defining the chemical and corrosion properties of reactor heat transport systems are the electrochemical potential and pH, both measured at the temperature of operation. The overall goal of this research program was to use several techniques developed at SRI over the last several years to measure the pH of various solutions in the temperature range 25°C to 300°C, and the electrochemical potential of alloy 600 and 690 in these carefully defined solutions. The YSZ pH electrode has the advantage that it can measure the pH in solutions where the hydrogen (platinum) electrode fails because the latter is affected by the redox potential of the solution and by other limitations. After the calibration was complete, the YSZ pH sensor was used to measure the pH of solutions over the temperature range 125°C to 300°C. In general, both acidic as well as alkaline solutions moved toward neutral pH values with increasing temperature. Finally, the corrosion potentials of Inconel 600 and 690 alloys measured as a function of temperature indicated that, in general, in acidic solutions, both alloys behave similar to the hydrogen electrode. However, in basic and neutral solutions, the potentials of the alloys and the hydrogen electrode were different, possibly due to the presence of dissolved oxygen (175 ppB) in our system.

40830 **(EPRI-NP—5246) Ultrasonic characterization of centrifugally cast stainless steel: Topical report.** Jeong, P. (Jones (J.A.) Applied Research Co., Charlotte, NC (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jun 1987. 281p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920484.

Ultrasonic wave propagation in centrifugally cast stainless steel (CCSS) was investigated. The difficulties of inspecting CCSS material stem from elastic anisotropy that hampers defect location and severe attenuation caused by coarse grains within the structure that makes defect detection difficult. During this investigation, grain effects on ultrasonic wave propagation were investigated, techniques for identifying different grain structures were developed, and compensation methods for grain effects were addressed. Each step is explained analytically based on relevant theory and proven experimentally. Experiments were conducted on specially designed test specimens: angled blocks, polygonal blocks, wedge blocks, and calibration blocks. Wave parameters such as phase velocity, skew angle, energy velocity, attenuation, beam width, amplitude variation patterns, and frequency dependence on grain structures were all measured with these specimens. CCSS grain structures investigated were equiaxed-fine grains, columnar-dendritic grains, and coarse grains. For comparison purposes, additional types of material such as static-cast stainless steel, forged stainless steel, and carbon steel materials were also investigated. Longitudinal wave, horizontally and vertically polarized shear wave modes were all considered in experiments. The use of an automated ultrasonic system was also demonstrated for grain structure identification.

40831 **(HEDL-SA—3533) Determination of gamma-ray-induced displacement rates.** Gold, R.; Roberts, J.H.; Doran, D.G. (Hanford Engineering Development Lab., Richland, WA (USA)). Jan 1987. Contract AC06-76FF02170. 16p. (CONF-8706134—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE87010712.

From 6. ASTM/EURATOM symposium; Jackson Hole, WY, USA (1 Jun 1987).

To define the gamma-ray component of the radiation field in light water reactor (LWR) pressure vessel (PV) environments, gamma-ray spectrometry experiments were conducted in the low power PV mockup at the poolside critical assembly (PCA) at ORNL. Gamma-ray displacement rates can be calculated directly from absolute electron spectra observed with the Janus probe gamma-ray spectrometry. Gamma-ray displacement results are presented for the 1/4-T, 1/2-T, and 3/4-T locations of the 12/13 and 4/12 simulated surveillance capsule (SSC) configurations. In addition, the gamma-ray displacement rate at the SSC location was inferred using thermoluminescent dosimeter (TLD) gamma-ray dosimetry results obtained in the 4/12 SSC configuration at the PCA. Compared with neutron-induced displacement rates, the calculated gamma-ray-induced displacement rates are small at all these LWR-PV locations. The ratio of gamma-ray-induced to neutron-induced displacement rates never exceeds roughly 5×10^{-3}.

40832 **(JAERI-M—86-118) Research on one-dimensional two-phase flow. Theory on hydrodynamic balance in two fluid model and its application.** Adachi, H. (Japan Atomic Energy Research Inst., Tokyo). Aug 1986. 180p. (In Japanese). NTIS (US Sales Only), PC A09/MF A01. File Number DE87702615.

In the Part I, the author describes the fundamental form of the hydraulic basic equations for a one-dimensional two-phase flow (two fluid model). Most of the discussions are concentrated on the treatment of phase change inertial force terms in the equations of motion and the author's equations of motion have a strong uniqueness on the following three points in comparison with conventional equations of motion. (1) To express force balance of unit mass two-phase fluid instead of that of unit volume two-phase fluid. (2) To pick up the unit existing mass and the unit flowing mass as the unit mass of two-phase fluid. (3) To apply the kinetic energy principle instead of the momentum low in the evaluation of stational inertia force term. In these three, the item (1) is for excluding a part of momentum change or kinetic energy change due to mass change of the elementary part of fluid, which is independent of force. The item (2) is not to introduce a phenomenological physical model into the evaluation of phase change inertial force term. And the item (3) is for correctly applying the momentum law taking into account the difference of representative velocities between the main flow fluid (vapor phase or liquid phase) and the phase change part of fluid. In the Part II, characteristics of various kinds of high speed two-phase flow are clarified theoretically by using the basic equations derived in the Part I. It is demonstrated that the steam-water two-phase critical flow with violent flashing and the air-water two-phase critical flow without phase change can be described with fundamentally the same basic equations. Furthermore, by comparing the experimental data from the two-phase critical discharge test and the author's theoretical prediction, the two-phase discharge coefficient, C/sub D/, for large sharp-edged orifice is determined as the value which is not affected by the experimental facility characteristics, etc.

40833 **(NUREG/CR—3228-Vol.5) Structural integrity of water reactor pressure boundary components: Annual report for 1986.** Loss, F.J. (ed.). (Materials Engineering Associates, Inc., Lanham, MD (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering). Jul 1987. 235p. (MEA—2207-Vol.5). NTIS, PC A11/MF A01 - GPO. File Number TI87900921.

This program is being conducted for the NRC to provide analytical and experimental methods and data that are necessary to ensure the structural safety and reliability of pressure boundary components in commercial, light water reactor power systems. Emphasis is placed on characterization of material properties performance in a nuclear environment for the application to plant-life extension and mitigation of the consequences of postulated accident scenarios. Current work is organized into three major tasks; (1) fracture mechanics investigations, (2) environmentally-assisted crack growth in high temperature, primary reactor water, and (3) radiation sensitivity and postirradiation properties recovery. Research progress in these three tasks for 1986 is summarized in this report.

40834 **(NUREG/CR—4300-Vol.4-No.1) Acoustic emission/flaw relationship for in-service monitoring of nuclear pressure vessels: Progress report, October 1986-March 1987.** Hutton, P.H.; Friesel, M.A. (Pacific Northwest Lab., Richland, WA (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering). Jun 1987. Contract AC06-76RL01830. 18p. (PNL—5511-Vol.4-No.1). NTIS, PC A02/MF A01 - GPO. File Number TI87011711.

This report discusses technical progress for the period October 1986 to March 1987 for the NRC-sponsored research program

concerned with "Acoustic Emission/Flaw Relationships for Inservice Monitoring of Nuclear Reactor Pressure Boundaries." Included in the discussion are the topics of AE monitoring of primary piping during reactor operation, development of AE/IGSCC relationships, evaluation of the effects of crack growth rate on detection of the associated AE, validation of the AE signal identification, and progress in developing an ASME Section XI Code appendix for continuous AE monitoring of pressure boundary components.

40835 **(NUREG/CR—4583-Vol.2) Development and validation of a real-time SAFT-UT system for the inspection of light water reactor components: Annual report, October 1984-September 1985.** Doctor, S.R.; Hall, T.E.; Reid, L.D.; Crawford, S.L.; Littlefield, R.J.; Gilbert, R.W. (Pacific Northwest Lab., Richland, WA (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering). Jun 1987. Contract AC06-76RL01830. 83p. (PNL—5822-Vol.2). NTIS, PC A05/MF A01 - GPO. File Number TI87011710.

The Pacific Northwest Laboratory is working to design, fabricate, and evaluate a real-time flaw detection and characterization system based on the synthetic aperture focusing technique for ultrasonic testing (SAFT-UT). The system is designed to perform inservice inspection of light-water reactor components. Included objectives of this program for the Nuclear Regulatory Commission are to develop procedures for system calibration and field operation, to validate the system through laboratory and field inspections, and to generate an engineering data base to support ASME Code acceptance of the technology. This progress report covers the programmatic work from October 1984 through September 1985.

40836 **(NUREG/CR—4744-Vol.1-No.2) Long-term embrittlement of cast duplex stainless steels in LWR systems: Semiannual report, April 1986-September 1986.** Chopra, O.K.; Chung, H.M. (Argonne National Lab., IL (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering). Mar 1987. Contract W-31109-ENG-38. 52p. (ANL—87-16). NTIS, PC A04/MF A01 - GPO. File Number TI87009441.

This progress report summarizes work performed by Argonne National Laboratory during the six months from April-September 1986 on long-term embrittlement of cast duplex stainless steels used in light-water reactors.

40837 **(WTSD-TME—153) Preliminary design report: Prototypical Spent Fuel Consolidation Equipment Demonstration Project: Phase 1.** Blissell, W.H.; Ciez, A.P.; Mitchell, J.L.; Winkler, C.J. (Westinghouse Electric Corp., Madison, PA (USA). Waste Technology Services Div.). Dec 1986. Contract AC07-86ID12649. 359p. NTIS, PC A16. File Number DE87012417.

This document describes the Westinghouse Preliminary Design for the Prototypical Consolidation Demonstration Project per Department of Energy (DOE) Contract No. DE-AC07-86ID12649 and under direction of the DOE Idaho Operations Office. The preliminary design is the first step to providing the Department of Energy with a fully qualified, licensable, cost-effective spent fuel rod consolidation system. The design was developed using proven technologies and equipment to create an innovative approach to previous rod consolidation concepts. These innovations will better enable the Westinghouse system to: consolidate fuel rods in a precise, fully-controlled, accountable manner; package all rods from two PWR fuel assemblies or from four BWR fuel assemblies in one 8.5 inch square consolidated rods canister; meet all functional requirements; operate with all fuel types common to the US commercial nuclear industry with minimal tooling changeouts; and meet consolidation production process rates, while maintaining operator and public health and safety. This Preliminary Design Report provides both detailed descriptions of the equipment required to perform the rod consolidation process and the supporting analyses to validate the design.

2102 Power Reactors, Non-breeding, Light-water Moderated, Non-boiling Water Cooled

REFER ALSO TO CITATION(S) 40494, 40816, 40822, 40823, 40824, 40825, 40826, 40827, 40828, 40829, 40830, 40831, 40832, 40833, 40834, 40835, 40836, 40837, 40887, 40892, 40895, 40896, 40934, 40951, 40965, 40966, 40967, 40969, 40982, 40988, 40989, 40990, 41009, 41012, 41024, 41027, 41028, 41029, 41030, 41031, 41033, 41034, 41043, 41044, 41045, 41048, 41049, 41050, 41051, 41053, 41054, 41055, 41056, 41057, 41058, 41059, 41060, 41061, 41062, 41067, 41072, 41074, 41076, 41554

40838 (EPRI-CS/NP—3016-Vol.4B, pp 2.3-2.21) **Modular Modeling System (MMS) code: a versatile power plant analysis package.** Divakaruni, S.M.; Wong, F.K.L. Apr 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920392. (CONF-8409396—Vol.4B).

From Workshop on Modular Modeling System (MMS); New Orleans, LA, USA (26 Sep 1984).

The basic version of the Modular Modeling System (MMS-01), a power plant systems analysis computer code jointly developed by the Nuclear Power and the Coal Combustion Systems Divisions of the Electric Power Research Institute (EPRI), has been released to the utility power industry in April 1983 at a code release workshop held in Charlotte, North Carolina. Since then, additional modules have been developed to analyze the Pressurized Water Reactors (PWRs) and the Boiling Water Reactors (BWRs) when the safety systems are activated. Also, a selected number of modules in the MMS-01 library have been modified to allow the code users more flexibility in constructing plant specific systems for analysis. These new PWR and BWR modules constitute the new MMS library, and it includes the modifications to the MMS-01 library. A year and half long extensive code qualification program of this new version of the MMS code at EPRI and the contractor sites, back by further code testing in an user group environment is culminating in the MMS-02 code release announcement seminar. At this seminar, the results of user group efforts and the code qualification program will be presented in a series of technical sessions. A total of forty-nine papers will be presented to describe the new code features and the code qualification efforts. For the sake of completion, an overview of the code is presented to include the history of the code development, description of the MMS code and its structure, utility engineers involvement in MMS-01 and MMS-02 validations, the enhancements made in the last 18 months to the code, and finally the perspective on the code future in the fossil and nuclear industry.

40839 (EPRI-CS/NP—3016-Vol.4B, pp 2.25-2.31) **Overview of MMS two-phase modules and formulation.** Sursock, J.P. Apr 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920392. (CONF-8409396—Vol.4B).

From Workshop on Modular Modeling System (MMS); New Orleans, LA, USA (26 Sep 1984).

The fundamental concepts and equations used in the development of the MMS Two-Phase Component Library are presented. Two-phase flow obeys all of the basic laws of fluid mechanics. The equations are merely more complicated or more numerous than those for single-phase flow. The general capabilities and characteristics of the Two-Phase Library can be summarized as follows: (1) can be applied to single-phase liquid or vapor flows as well as two-phase flows; (2) uses drift-flux concepts to analytically model one-dimensional two-phase flows; (3) applicable to normal and/or reverse flow phenomena; (4) includes treatment of level tracking, counter-current flow and flooding; and (5) can be used with the single-phase modules through the use of interface modules.

40840 (EPRI-CS/NP—3016-Vol.4B, pp 2.55-2.64) **Enhancements to the single-phase MMS modules.** Smith, L.P. Apr 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920392. (CONF-8409396—Vol.4B).

From Workshop on Modular Modeling System (MMS); New Orleans, LA, USA (26 Sep 1984).

Experience with MMS-Revision 0 by the MMS Pre-Release User Group and during various research projects conducted during that time period identified a number of areas where the MMS

MACRO library could be improved. In general these improvements made the modules more user friendly or extended their range of applicability. All of the modifications have been tested for reasonability by the developers and most of these modules have been tested by the user group utilizing the TESTREV1 library. These modules, together with the majority of the unchanged modules and a small set of new modules, constitute MMS-Revision 1. The Revision 1 MACRO library increased in size to 45 modules by comparison to 40 in the Revision 0 library.

40841 (EPRI-CS/NP—3016-Vol.4B, pp 3.3-3.10) **MMS two-phase nonequilibrium pressurizer.** Oh, S.J.; Sursock, J.P. (JAYCOR, San Diego, CA). Apr 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920392. (CONF-8409396—Vol.4B).

From Workshop on Modular Modeling System (MMS); New Orleans, LA, USA (26 Sep 1984).

The pressurizer of a nuclear steam supply system establishes and maintains the nuclear plant primary loop pressure within the prescribed limit. It is a vertical cylindrical vessel which provides a water reserve and a steam surge chamber to accommodate coolant density changes during operation. To adjust the pressure to a desired value, electric heaters are provided in its lower section and the spray nozzles are provided in its upper section. Also, to protect against the buildup of the excess pressure, the pressurizer has two different types of relief valves, i.e., power operated relief valve and the safety relief valve. The pressurizer model implemented to the MMS is described in detail. In particular, the handling of the nonequilibrium condition, surgeline CCFL (Counter-current Flooding Limitation), and the level tracking model are described in detail. Next, the simulation of the Shippingport pressurizer load drop test is reported.

40842 (EPRI-CS/NP—3016-Vol.4B, pp 3.57-3.70) **MMS simulation of oscillatory flow during reflooding of a pressurized water reactor.** Ghiaasiaan, S.M.; Wassel, A.T. (Science Applications International Corp., Hermosa Beach, CA). Apr 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920392. (CONF-8409396—Vol.4B).

From Workshop on Modular Modeling System (MMS); New Orleans, LA, USA (26 Sep 1984).

An MMS PWR reflood model was developed which couples the thermal-hydraulics of the core, lower plenum and downcomer. A method is presented which describes the oscillatory flow phenomenon which occurs during gravity reflooding. A numerical procedure is developed to solve the governing global momentum equation. This procedure is shown to be numerically stable and computationally efficient. Model predictions were compared against the data of the FLECHT-SET experiments and showed good agreement. The MMS reflood module, when coupled with the rest of the primary coolant system modules, will calculate the reflood phase of a LOCA.

40843 (EPRI-CS/NP—3016-Vol.4B, pp 7.3-7.24) **EPRI plant analyzer. Part II. PWR applications.** Ipakchi, A.; Peng, C.M.; Divakaruni, M.; Sun, B.K.H. (System Control, Inc., Palo Alto, CA). Apr 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920392. (CONF-8409396—Vol.4B).

From Workshop on Modular Modeling System (MMS); New Orleans, LA, USA (26 Sep 1984).

A full-plant TMI-2 dynamic model of a Babcock and Wilcox (B & W) nuclear power plant was constructed with the Modular Modeling System (MMS) code package and was validated against several transients corresponding to B & W plant procedure. The model was implemented on a PRIME-750 minicomputer in conjunction with the displays developed under another EPRI research project DASS. A modular software framework integrated the MMS software and the display software into a dynamic simulator, referred to as a compact analyzer. The user can manipulate or activate control systems interactively and review the system behavior on the displays. It is also possible to set up calculations either in batch or interactive mode for subsequent plotting or replays of the results of selected scenarios through the displays for review by the management or operations personnel. Execution time issues are discussed and improvements of run time are suggested.

40844 (EPRI-CS/NP—3016-Vol.4B, pp 7.37-7.56) **Modeling of Wolf Creek Generating Station Kansas Gas and Electric Company.** Hseu, J.S.; Fu, S.W. (Kansas Gas & Electric, Wichita). Apr 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920392. (CONF-8409396—Vol.4B).

From Workshop on Modular Modeling System (MMS); New Orleans, LA, USA (26 Sep 1984).

The objectives of this study were to: assess the potential for using MMS as a tool for future engineering applications; develop a working model, BOP in particular, that could be used for future analytical work on the system modeled; and to build an in-house modeling capability for analyzing and understanding the thermal-hydraulic behavior and systems performance of the plant. The Wolf Creek Generating Station, SNUPPS Unit 1, has a nominal rating of 1150 MWe. The unit includes a General Electric, 1800 rpm, tandem-compound, six-flow turbine generator supplied with steam from a Westinghouse pressurized water reactor rated at 3425 MWt. The ultimate goal of the MMS modeling effort is to develop a working model for the entire secondary plant of Wolf Creek Generating Station. To accomplish this, the secondary plant has been divided into the following modular subsystems: high pressure feedwater heater train, low pressure feedwater heater train, power conversion system, and U-tube steam generators. The MMS model for each subsystem will be generated, debugged and executed independently before they are merged together to form the entire secondary plant. The results of the modeling effort on the models of high pressure feedwater heater train and steam generator level control system are presented.

40845 (EPRI-CS/NP—3016-Vol.4B, pp 7.59-7.74) **Verification of a feedwater heater drain system model by comparison with plant test data.** Stambaugh, N. (Duke Power Co., Charlotte, NC). Apr 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920392. (CONF-8409396—Vol.4B).

From Workshop on Modular Modeling System (MMS); New Orleans, LA, USA (26 Sep 1984).

A thirteen state feedwater heater drain system model and the actual heater drain system itself, were both subjected to a pump-trip transient. The response of the model was compared to the response of the system in the plant. Initially, the responses did not match-up. A detailed review of the plant test data revealed a five second time delay between the dump valve demand signal and the initial movement of the dump valve. When this delay was incorporated into the model, the responses matched-up perfectly. The drastic effect its minor detail had on the model response pointed out the need to model the control system exactly like the as-built system in order to accurately predict system transients. In addition, the five second time delay was later found to exist as design data, thus proving the ability of the MMS model to accurately match plant test data using only design information. The primary objective of this modeling effort was to verify the ability of MMS to accurately simulate and predict responses of a plant system to normal operating transients. A single E heater drain system was chosen for its accessibility for testing as well as for its known history of instability. By both verifying the model and solving an instability problem, it was hoped that confidence in MMS could be built-up and the initial skepticism concerning practical applications overcome.

40846 (EPRI-CS/NP—3016-Vol.4B, pp 7.93-7.120) **Loss of feedwater heater analysis for the South Texas Project.** Joyce, K.C.; Johnson, M.R.; Albury, C.R. (Houston Lighting & Power, TX). Apr 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920392. (CONF-8409396—Vol.4B).

From Workshop on Modular Modeling System (MMS); New Orleans, LA, USA (26 Sep 1984).

The results of the steady state and transient analyses of the low pressure feedwater heater train for the South Texas Nuclear Project are presented. The South Texas Project consists of two 1250 MW Westinghouse PWR units. This analysis was performed using the Modular Modeling System (MMS) simulation code. The model presented will be incorporated into the secondary side model in support of the plant training simulator and the analysis of secondary side transients. Results of this analysis are considered pre-

liminary until benchmarked against actual plant data. A model description of the feedwater heater train from the condensate pumps to the deaerator is presented. The methodology used to develop the model is also discussed. Results of the steady state run are presented, and a transient, the loss of extraction steam to feedwater heater 15A, is examined.

40847 (EPRI-CS/NP—3016-Vol.4B, pp 7.139-7.157) **Assessing operability of a novel polisher arrangement using MMS.** Shor, S.W.W. (Bechtel Group, Inc., San Francisco, CA). Apr 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920392. (CONF-8409396—Vol.4B).

From Workshop on Modular Modeling System (MMS); New Orleans, LA, USA (26 Sep 1984).

A condensate polisher is intended to remove both particulate matter and ionic material from the condensate. Condensate polishers have normally been placed directly in the condensate system downstream of the condensate pumps. This inline location has certain disadvantages. These disadvantages are discussed. Placing the polisher in a sidestream location, where water is removed from the condensate system, pumped through the polisher, and then returned to the condensate system provides a solution to these disadvantages. Several possible types of sidestream installations is described. This has a polisher taking unpolished condensate from one compartment from one compartment of a divided hotwell in a specially modified condenser and returning polished condensate to the other compartment. The polisher is supplied by its own dedicated pumps, which have a head requirement sufficient only to overcome the pressure drop through the polisher circuit at a flow rate of 110% of maximum condensate flow. This concept is very attractive but has not yet been tested even though it is being installed in several new units. A simulation was, therefore, performed using MMS to provide confidence that this particular sidestream polisher arrangement was operationally viable.

40848 (EPRI-CS/NP—3016-Vol.4B, pp 8.65-8.73) **Robust method for determining steady state initial values for MSS plant models.** Ringham, M.R.; Carlson, J.R. (Jaycor, San Diego, CA). Apr 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920392. (CONF-8409396—Vol.4B).

From Workshop on Modular Modeling System (MMS); New Orleans, LA, USA (26 Sep 1984).

Results of an EPRI sponsored project (RP 2504-3 amend i) demonstrated that the methodology embodied in the existing System Performance and Analysis Code (SPANC) can be employed to provide initial values for MSS plant models. An EASY5 version of the TMI plant two loop approximation with primary coolant flow recirculation through a failed pump was selected for demonstration purposes. The project entailed replacing the 1967 ASME steam properties in SPANC with the simplified MSS functions. The MSS component models were then recast into equivalent steady state models compatible with the SPANC executive system. A special input routine was written to modify the MSS data to the SPANC data format. The accuracy of the obtained initial values was approximately four significant figures, sufficient to converge on the EASY5 steady state algorithms. Convergence is relatively insensitive to the initial guess in SPANC and are obtained at a computer cost of approximately two minutes on the UNIVAC 1100/60. Since plant configuration is established by data input in SPANC, it can easily be altered to provide initial values for an MMS simulation of all TMI type plants.

40849 (EPRI-NP—5131) **Inspection of centrifugally cast stainless steel components in PWRs [pressurized water reactors]: Final report.** Egan, G.R.; Capener, E.L.; Hedgecock, P.D.; Cipolla, R.C.; Clark, E.B. (Aptech Engineering Services, Inc., Palo Alto, CA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jun 1987. 162p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920487.

This report addresses the state of knowledge in flaw detection within cast stainless steel and the mechanics of the long-term aging processes. The programs, both domestic and foreign, which address these issues have been reviewed. The available information concerning flaws in both static and centrifugally cast materials has been examined. Problems in nuclear power plants employing both statically and centrifugally cast stainless steel have not manifested themselves, thereby, suggesting high reliability. To date, from a review of operating experience, centrifugally cast stainless piping has displayed no problems. The only indication of likely flaws and their detectability has come from statically cast pump bodies. From this base, the likely nature of flaws in centrifugally cast piping has been postulated and the likelihood of growth and achievement of critical dimensions examined. It is concluded that the flaw evaluation procedures of the ASME Code can be extended to the cast piping products on the basis that weldments are of initially lower fracture toughness than the pipe. Based on the outcome of current thermal aging programs, the point in plant life at which the pipe dominates flaw evaluation procedures will be better determined. Fatigue crack growth considerations suggest that large flaws can be present in pipe welds or fully-aged base pipe, while maintaining adequate safety margins.

40850 (EPRI-NP—5199-Vol.1) **Chemical enhancement of crevice flushing: Volume 1, Results and discussion: Final report.** Baum, A.J.; Prestegiacomo, J.B. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Steam Generator Technology Div.; Electric Power Research Inst., Palo Alto, CA (USA)). Jun 1987. 146p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920469.

The primary objective of this project was to evaluate the effect of various chemical additives on enhancing the hideout return produced during tubesheet crevice flushing operations in PWR steam generators. Secondary objectives included determining if flushing was an effective means of introducing a corrosion inhibitor into deep tubesheet crevices, and evaluating the effects of different degrees of crevice restriction, different initial crevice chemistries, and different flushing processes. Testing was unable to identify a single additive formulation which increased the flushing effectiveness for all degrees of crevice restriction considered. Testing did reveal that a combination of surfactant (Surfynol 104) and boric acid enhances the flushing effectiveness in tests with moderately restricted crevices. Although cleaning agents were found to increase the flushing effectiveness in tests with extensively restricted crevices, potential corrosion concerns and relatively high contaminant (sodium) levels could discourage their use. However, the testing demonstrated that flushing was an effective means of accumulating a corrosion inhibitor, such as boric acid, in deep tubesheet crevices. Companion testing also indicated that boric acid which accumulated in a tubesheet crevice during crevice flushing was likely to remain in the crevice during subsequent power operation. Consequently, use of boric acid as an additive in tubesheet crevice flushing operations is strongly recommended.

40851 (EPRI-NP—5248) **Investigation of causes and corrective actions for pitting in steam generator tubes: Prototypic tests: Final report.** Hall, J.F.; Frisk, R.S.; Marugg, K.E.; O'Neill, A.S. (Combustion Engineering, Inc., Windsor, CT (USA). Nuclear Power Systems; Electric Power Research Inst., Palo Alto, CA (USA)). Jun 1987. 265p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920488.

Severe pitting has occurred in the NiCrFe Alloy 600 steam generator tubes in several pressurized water reactors. Neither results of destructive examinations of tubes removed from the affected units nor existing literature data were sufficient to identify either causes or cures of the pitting phenomena. The laboratory test program described in this report was directed toward defining the conditions under which pits initiate and propagate, and identifying and testing the effectiveness of possible corrective actions. The test program included the fabrication and testing of two pot boiler test units. The internals of each unit consisted of four NiCrFe Alloy 600 tubes with concentrating devices attached to provide steam blanketed areas where contaminants could concentrate. The two tests operated with a variety of faulted secondary water environments. The results of the test program showed that an aerated seawater/$CuCl_2$ fault environment with heat transfer and areas of concentration will produce pits with all the characteristics of the pits observed in field units. Cu is a major accelerant for the pitting process; however, pitting will eventually occur in oxygenated seawater faulted environments which contain no Cu or Cu com-

pounds. Dissolved oxygen is required for the initiation of pitting. Once pitting has initiated, removal of oxygen will eliminate further initiation and over a period of time will halt propagation. Removal of sludge piles and thick tube deposits, which provide areas for concentration of contaminants, will result in elimination of pit initiation and may reduce propagation rates in existing pits. Boric acid additions, at the level tested, are not effective in preventing pit initiation. A high pH morpholine environment, even in the presence of aerated seawater/$CuCl_2$, may be an effective inhibitor for initiation.

40852 **(EPRI-NP—5249-Vol.1) Qualification of remedial methods to prevent primary-side stress corrosion cracking of steam generator tubing: Volume 1, Shot peening: Final report.** Frederick, G.; Hernalsteen, P.; Stubbe, J. (Electric Power Research Inst., Palo Alto, CA (USA); Belgatom S.A., Brussels (Belgium)). Jun 1987. 212p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920508.

Primary side cracking has been observed within the mechanically expanded area in a significant number of tubes of PWR steam generators in Europe, in Japan and to a lesser extent in the USA. A program was launched by the Belgian utilities and was further cosponsored by the Steam Generator Owners Group (SGOG)/Electric Power Research Institute (EPRI) to develop preventive actions applicable to steam generators under radioactive and/or non-radioactive conditions. These preventive measures included: introduction of residual compressive stresses on ID by shot- or roto-peening without inducing unacceptable tensile stresses on OD; and stress relaxation and metallurgical improvement of the material by an in situ heat treatment of the whole tubesheet. The qualification and first site application of shot-peening are presented in this volume of the report. Roto-peening and global heat treatment are presented respectively in Volumes 2 and 3.

40853 **(EPRI-NP—5249-Vol.2) Qualification of remedial methods to prevent primary-side stress corrosion cracking of steam generator tubing: Volume 2, Rotopeening: Final report.** Frederick, G.; Hernalsteen, P.; Stubbe, J. (Electric Power Research Inst., Palo Alto, CA (USA); Belgatom S.A., Brussels (Belgium)). Jun 1987. 293p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920509.

Primary side cracking has been observed within the mechanically expanded area in a significant number of tubes of PWR steam generators in Europe, in Japan and to a lesser extent in the USA. A program was launched by the Belgian utilities and was further co-sponsored by the Steam Generator Owners Group (SGOG)/Electric Power Research Institute (EPRI) to develop preventive actions applicable to both new and operating steam generators. These preventive measures included: introduction of residual compressive stresses on the ID by shot- or roto-peening without inducing unacceptable tensile stresses on OD; stress relaxation and metallurgical improvement of the material by an in situ heat treatment of the whole tubesheet. The qualification and first full-scale application of roto-peening at two Belgian sites are presented in this volume of the report.

40854 **(EPRI-NP—5266) On-line monitoring of secondary-cycle chemistry with morpholine at the Beaver Valley Power Station: Final report.** Riddle, J.M.; Burns, G.D.; Crutchfield, J.E.; Nolan, C.R. (NUS Operating Services Corp., Pittsburgh, PA (USA). Radiation Protection and Chemistry Services Dept.; Electric Power Research Inst., Palo Alto, CA (USA)). Jun 1987. 140p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920501.

Beaver Valley is the only PWR with vertical steam generators in the United States which has used morpholine in the all-volatile chemistry control program for its entire operating history. Morpholine is very similar to proposed alternatives to ammonia. Hence, a careful study of its benefits and side effects may provide an indication of the value of additives similar to, but superior to, morpholine. On-line chromatography was used to characterize morpholine, ammonia, organic acids, chloride, fluoride, and sulfate levels at Beaver Valley during operation with different morpholine feed rates. This study verified the feasibility of using on-line ion chromatography to monitor secondary cycle pH control agents, organic acids, and ionic impurities. Morpholine usage will elevate steam generator blowdown cation conductivity by approximately 0.1 to 0.15 μS/cm as a result of acetic and formic acids. However, organic acid levels do not increase in proportion to morpholine levels, suggesting a threshold reaction that is satisfied at low (e.g., 0.2 ppM) morpholine levels.

40855 **(EPRI-NP—5267-Vol.1) Weld region corrosion during chemical cleaning of PWR [pressurized-water reactor] steam generators: Volume 1, Overview and discussion: Final report.** Hildebrandt, P.C.; Nestell, J.E.; Trench, R.C.; Varrin, R.D. (MPR Associates, Inc., Washington, DC (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jul 1987. 89p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920521.

The potential for preferential corrosion of steam generator weld regions during chemical cleaning using the generic SGOG solvents was investigated. The investigations included development and use of a corrosion assessment test facility which measured corrosion currents in a realistic model of the steam generator geometry in the vicinity of a specific weld during a simulated chemical dissolution of sludge consisting of essentially pure magnetite. A corrosion monitoring technique was developed and qualified. In this technique free corrosion rates measured by linear polarization techniques are added to corrosion rates calculated from galvanic current measured using a zero resistance ammeter to give an estimate of total corrosion rate for a galvanically corroding material. An analytic modeling technique was developed and proved useful in determining the size requirements for the weld region mockup used in the corrosion assessment test facility. The test results obtained during this investigation indicated that chemical cleaning using the SGOG magnetite dissolution solvent can be performed with a small amount of corrosion of secondary side internals and pressure boundary welds.

40856 **(EPRI-NP—5267-Vol.2) Weld region corrosion during chemical cleaning of PWR [pressurized-water reactor] steam generators: Volume 2, Tests and analyses: Final report.** Barna, J.L.; Bozeka, S.A.; Jevec, J.M.; Miglin, B.P.; Scott, M.E.; Turner, C.R.; Beineke, T.A.; Fortier, M.L.; Machnicki, J.P.; Strohm, E.O. (Babcock and Wilcox Co., Alliance, OH (USA). Research and Development Div.; Combustion Engineering, Inc., Windsor, CT (USA); Westinghouse Research and Development Center, Pittsburgh, PA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jul 1987. 804p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920520.

The potential for preferential corrosion of steam generator weld regions during chemical cleaning using the generic SGOG solvents was investigated. The investigations included development and use of a corrosion assessment test facility which measured corrosion currents in a realistic model of the steam generator geometry in the vicinity of a specific weld during a simulated chemical dissolution of sludge consisting of essentially pure magnetite. A corrosion monitoring technique was developed and qualified. In this technique free corrosion rates measured by linear polarization techniques are added to corrosion rates calculated from galvanic current measured using a zero resistance ammeter to give an estimate of total corrosion rate for a galvanically corroding material. An analytic modeling technique was developed and proved useful in determining the size requirements for the weld region mockup used in the corrosion assessment test facility. The technique predicted galvanic corrosion rates consistent with that observed in a corrosion assessement test when polarization data used as model input were obtained on-line during the test. The test results obtained during this investigation indicated that chemical cleaning using the SGOG magnetite dissolution solvent can be performed with a small amount of corrosion of secondary side internals and pressure boundary welds. The maximum weld region corrosion measured during a typical chemical cleaning cycle to remove essentially pure magnetite sludge was about 8 mils. However, additional site specific weld region corrosion assessment testing and qualification will be required prior to chemical cleaning steam generators at a specific plant. Recommendations for site specific qualification of chemical cleaning processes and for use of process monitors and on-line corrosion instrumentation are included in this report.

40857 **(HEDL-SA—3317) Light water reactor pressure vessel surveillance using reactor cavity solid state track recorder neutron dosimetry.** Ruddy, F.H.; Roberts, J.H.; Gold, R.; Preston, C.C.; Kellogg, L.S.; Lippincott, E.P.; McElroy, W.N. (Hanford Engineering Development Lab., Richland, WA (USA)). 14 Jun 1985. Contract AC06-76FF02170. 7p. (CONF-850933—12). NTIS, PC A02. File Number DE87010724.

From 13. international conference on solid state nuclear track detectors; Rome, Italy (23 Sep 1985).

Solid State Track Recorder (SSTR) Neutron Dosimeters have been developed for use in power reactors to provide information on the cumulative neutron dose received by the reactor pressure vessel during operation. The accumulation of neutron dose by the pressure vessel results in radiation damage in the form of steel embrittlement. In order to ascertain the safe operating lifetime of the reactor pressure vessel, the results of dosimeter measurements are evaluated and used to estimate the extent of radiation damage. Among the requirements for SSTR neutron dosimetry are high accuracy and ability to provide useful data at high neutron fluences. To this end, ultra low-mass fissionable deposit preparation techniques have been developed, and the absolute accuracies of the measurements have been maintained at the 3 to 5% level. The status of the deployment of SSTR dosimetry capsules in the reactor cavity region of operating power reactors will be summarized.

40858 **(IKE—6-170) Fast reactor cycle calculation routine using a 3D-simulator and investigation of new burnup stategies for pressurized water reactors.** Li Yulun. (Stuttgart Univ. (Germany, F.R.). Inst. fuer Kernenergetik und Energiesysteme). Mar 1987. 172p. (In German). NTIS, PC E14; Available from NTIS as TIB/B87-07774.

Three-dimensional calculations of the longtime behaviour of PWR can be done in short computing times with satisfactory accuracy for power and burn-up distributions. This has been proved by comparison with operational data of Biblis-B. Various possibilities are investigated to increase the discharge burn-up and to improve the utilization of uranium. In view of the increase of discharge burn-up due to enhanced cycle number (decreased batch size) and decreased neutron leakage these new strategies are intensively studied in the conventional fuel management scheme (Out-in) and in the low leakage fuel management scheme (In-Out). By a conventional fuel management scheme with four cycle operation and a low leakage fuel management scheme with three cycle operation an attractive increase of discharge burn-up to about 40% can be achieved by an increase in the reload enrichment to 4%.

40859 **(KFK—4145) Data report REBEKA-7.** Wiehr, K.; Harten, U. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorbauelemente; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Nukleare Sicherheit). Feb 1987. 118p. (In German). NTIS, PC E11; Available from NTIS as TIB/B87-09397.

REBEKA-7 is an out-of-pile cladding deformation experiment with reflooding in a 7 x 7 bundle configuration of full length of a pressurized water reactor fuel element. This experiment was carried out with the same flow direction of the coolant during the refill- and reflood phases of a LOCA. This data report is a graphic summary and includes all essential measured data of the REBEKA-7 test. It is a supplement to the final REBEKA evaluation report. A detailed description of the measuring points is given. All measured data of the experiment are available at a data bank. Pressure and temperature transients of all individual rods at the axial elevation of 2100 mm and partly of 1850 mm are plotted. The data report contains also measured axial strain profiles of the individual Zircaloy cladding tubes as well as calculated cooling channel blockages for subchannels and the whole bundle. The points of burst of Zircaloy claddings and their position relative to the measuring points are given.

40860 **(NUREG/CR—4863) Surface spectroscopy of pressure vessel steel fatigue fracture surface films formed in PWR [pressurized water reactor] environments.** Hanninen, H.E.; Vulli, M.; Cullen, W.H. (Materials Engineering Associates, Inc., Lanham, MD (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering). Jul 1987. 98p. (MEA—2194). NTIS, PC A05 - GPO. File Number DE87900923.

The composition and structure of corrosion products formed on corrosion fatigue fracture surfaces of pressure vessel steels tested in PWR-water conditions have been analyzed by using X-Ray Photoelectron Spectroscopy (XPS) and Auger Electron Spectroscopy (AES) techniques. This was the first time these electron spectroscopic techniques have been applied to corrosion fatigue fracture surface studies. The oxide phase on the corrosion fatigue fracture surfaces was Fe_3O_4 (magnetite) in all the specimens. Small amounts of sulfur (typically about 3 atomic percent) were present in the oxide film mainly as FeS_2. In specimens showing the highest crack growth rates, the amount of sulfur was about doubled near the crack tip as compared to the value obtained further behind the crack tip in the middle of the fracture surface. It was possible to locate the crack-tip condition on the high-temperature Pourbaix diagram in the area where both magnetite and FeS_2 are stable phases. The anticipated crack-tip conditions are that the corrosion potential is about -500 mV(SHE) or less and the pH value is neutral or slightly acid. XPS and AES analyses of the corrosion fatigue fracture surfaces were found to reveal the possible water chemistry impurities during the corrosion fatigue tests, like Cl, Na, Ca, etc.

2103 Power Reactors, Non-breeding, Graphite Moderated

REFER ALSO TO CITATION(S) 40885, 40887, 40963, 40968, 41018, 41020, 41023, 41026, 41337, 41975

40861 **(CONF-870636—14) Analysis of piping system response to seismic excitations.** Wang, C.Y. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 9p. NTIS, PC A02. File Number DE87011440.

From 5. national congress on pressure vessels and piping; San Diego, CA, USA (28 Jun 1987).

This paper describes a numerical algorithm for analyzing piping system response to seismic excitations. The numerical model of the piping considers hoop, flexural, axial, and torsional modes of deformation. Hoop modes generated from internal hydrodynamic loading are superimposed on the bending and twisting modes by two extra degrees of freedom. A time-history analysis technique using the implicit temporal integration scheme is addressed. The time integrator uses a predictor-corrector successive iterative scheme which satisfies the equation of motion. Both geometrical and material nonlinearities are considered. Multiple support excitations, fluid effect, piping insulation, and material dampings can be included in the analysis. Two problems are presented to illustrate the method. The results are discussed in detail.

40862 **(GA-A—18566) Helium circulator design considerations for modular high temperature gas-cooled reactor plant.** McDonald, C.F.; Nichols, M.K. (GA Technologies, Inc., San Diego, CA (USA)). Dec 1986. Contract AC03-84SF11963. 12p. (CONF-870505—1). NTIS, PC A02. File Number DE87003847.

From 32. international gas turbine conference and exhibition; Anaheim, CA, USA (31 May 1987).

Efforts are in progress to develop a standard modular high temperature gas-cooled reactor (MHTGR) plant that is amenable to design certification and serial production. The MHTGR reference design, based on a steam cycle power conversion system, utilizes a 350 MW(t) annular reactor core with prismatic fuel elements. Flexibility in power rating is afforded by utilizing a multiplicity of the standard module. The circulator, which is an electric motor-driven helium compressor, is a key component in the primary system of the nuclear plant, since it facilitates thermal energy transfer from the reactor core to the steam generator; and, hence, to the external turbo-generator set. This paper highlights the helium circulator design considerations for the reference MHTGR plant and includes

a discussion on the major features of the turbomachine concept, operational characteristics, and the technology base that exists in the US.

40863 (JAERI-M—86-120) Irradiation creep properties of a graphite for HTGRs. Oku, T.; Fujisaki, K.; Eto, M. (Japan Atomic Energy Research Inst., Tokyo). Aug 1986. 30p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. File Number DE87702814.

Two irradiation creep tests on near isotropic graphite (SM1 - 24) for HTGRs were performed at around 900 C in the JMTR. Neutron fluences ranged from 5.50 x 10^{24} n/m^2 (E > 29fJ) to 12.4 x 10^{24} n/m^2 (E > 29fJ), depending on the position of the specimen. Irradiation creep strain (ϵ/sub c/) was obtained from the equation, ϵ/sub c/ = (σ/E_0) [1-exp(-bphi)] + Kσphi, by measuring dimensional changes in unloaded and loaded tensile specimens before and after irradiation, where E_0 is Young's modulus before irradiation, K creep coefficient, and b a constant. The value of K was estimated assuming that 1 - exp(-bPHI) = 1 over a range of neutron fluence tested here. Mercury porosimetry was made to add consideration to the mechanism of irradiation creep using unloaded and loaded specimens. Irradiation creep strain is proportional to stress and to neutron fluence for larger fluences. Irradiation creep coefficient is in inverse proportion to Young's modulus before irradiation, KE_0 = 0.247. From the values of the average Young's moduli before irradiation for two irradiation creep tests, the creep coefficients were estimated to be 3.03 x 10^{-29} $(MPa/m^2)^{-1}$ and 3.18 x 10^{-29} $(MPa/m^2)^{-1}$. Mercury pore diameter distribution changes by irradiation, that is, pores smaller than 10 μm disappear partly, the total porosity decreases, and the stress tends to facilitate disappearance of pores. Young's modulus increases by irradiation.

40864 (JAERI-M—86-144) Consideration of heat transfer performance of helium-gas/water coolers in HENDEL. Inagaki, Y.; Miyamoto, Y. (Japan Atomic Energy Research Inst., Tokyo). Oct 1986. 40p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. File Number DE87702626.

The helium engineering loop (HENDEL) has four helium-gas/water coolers, where the cooling water flows in the tubes and the helium gas flows on the shell side. Their cooling performance depends on mainly the heat transfer of helium gas on the shell side. This report describes the operational data of the coolers and the consideration of the heat transfer performance which is important for the design of coolers. It becomes clear that Donohue's equation is close to the operational data and conservative for the segmental baffle type cooler and preduction by Fishenden-Saunders or Zukauskas' equation is conservation for the step-up baffle type cooler.

40865 (JAERI-M—86-146) Fractional release of short-lived noble gases and iodine from HTGR fuel compact containing a fraction of coated fuel particles with through-coating defects. Ogawa, T.; Fukuda, K.; Kobayashi, F.; Kikuchi, T.; Tobita, T.; Kashimura, S.; Kikuchi, H.; Yamamoto, K. (Japan Atomic Energy Research Inst., Tokyo). Oct 1986. 24p. (In Japanese). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702628.

Fractional release (R/B) data of short-lived noble gases and iodine from sweep-gas irradiated HTGR fuel compacts were analyzed. Empirical formulas to predict R/B of ^{88}Kr as a function of temperature and fraction through-coating defects, and to calculate ratios of R/B's of other shortlived gases to that of ^{88}Kr were proposed. A method to predict R/B of iodine was also proposed. As for ^{131}I, a fission product of major safety concern, (R/B)/sub I(sub 131)/ ≃ (R/B)/sub Xe(sub 133)/ was predicted. Applying those methods, R/B from OGL-1 fuel element (5th and 6th) was predicted to show a good agreement with observation.

40866 (JAERI-M—86-165) Study on the role of very high temperature reactor and nuclear process heat utilization in future energy systems. Impact analysis of future energy technologies on long-term energy supply-demand, national economy, and environment. Yasukawa, S.; Mankin, S.; Tadokoro, Y.; Sato, O.; Yamaguchi, K.; Ueno, S. (Japan Atomic Energy Research Inst., Tokyo). Nov 1986. 52p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87702639.

This report describes the analytical results being made in the study on the role of Very High Temperature Reactor and nuclear process heat utilization in future energy system, which is aimed at zero emission. In the former part of the report, the modeling of the reference energy system, main characteristics of energy technologies, and scenario indicators as well as system behavioral objectives for optimization are explained. In the latter part, analytical results such as the time-period variation of overall energy utilization efficiency, energy supply/demand structure in long-terms, energy contribution and economic competition of new energy technologies, environmental effluents released through various energy activities, impacts to and from national economy, and some sensitivity analyses, are reviewed.

40867 (Juel—2093) Determination of the wall heat transfer coefficient in pebble beds. Hahn, W.; Achenbach, E. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorbauelemente). Oct 1986. 73p. (In German). NTIS, PC E09; Available from NTIS as TIB/B87-07778.

The prediction of the temperature distribution in a packed bed requires the knowledge of the effective thermal conductivity in the core and the wall heat transfer coefficient. Empirical correlations published previously yield strongly differing results varying by a factor of ten at low Reynolds numbers. Very high Reynolds numbers had not yet been investigated. Wall heat transfer coefficients in pebble beds were achieved by applying the analogy between heat and mass transfer on sublimation of napthalene into air. The use of mass transfer instead of heat transfer techniques provides some advantages concerning secondary effects. Two series of tests applying napthalene mass transfer were performed in the ranges of Reynolds number 5 x 10/sup 1/ ≦ Re ≦ 6 x 10/sup 3/ and 2 x 10/sup 3/ ≦ Re ≦ 2 x 10/sup 4/. Moreover, the mass transfer in the inlet section was investigated. The results of both test series match well. A good agreement is observed with earlier published data, which were not affected by entrance effects. The data are correlated for the range of Reynolds numbers 5 x 10/sup 1/ ≦ Re ≦ 2 x 10/sup 4/. The transition effect observed at Re ≃ 4 x 10/sup 3/ is explained by a change of the flow structure. A correlation is given for the mass and heat transfer in the entrance section.

40868 (Juel-Spez—378) Procedure for the decomposition of graphite reactor fuel elements by high pressure water jets. Thiele, D. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Chemische Technologie der Nuklearen Entsorgung). Nov 1986. 12p. (In German). NTIS, PC E07; Available from NTIS as TIB/B87-07807.

In the first step of HTR-fuel element reprocessing graphite is separated from heavy metal. The procedure suggested in this report works with a rotating high pressure water jet, which washes out the fuel particles without damage and separates them with a sieve from the graphite suspension. This way, an evaporation of the radioactive isotopes, carbon 14 included, can be avoided.

2104 Power Reactors, Non-breeding, Otherwise Moderated Or Unmoderated

REFER ALSO TO CITATION(S) 41531

40869 (EGG-M—00787-Rev.1) Heat transfer for ultra-high flux reactor. Wadkins, R.P.; Lake, J.A.; Oh, C.H. (EG and G Idaho, Inc., Idaho Falls (USA)). 1987. Contract AC07-76ID01570. 22p. (CONF-870816—16-Rev.1). NTIS, PC A02/MF A01; GPO Dep. File Number DE87009756.

From 24. national heat transfer conference and exhibition; Pittsburgh, PA, USA (9 Aug 1987).

The use of a uniquely designed nuclear reactor to supply neutrons for materials research is the focus of recent reactor design efforts. The biological, materials, and fundamental physics aspects of research require neutron fluxes much higher than present research and testing facilities can produce. The most advanced research using neutrons as probing detectors is being done in the High Flux Reactor at the Institut Laue Langeuin, France. The design of a reactor that can produce neutron fluxes of 1.0 x 10^{16} n/cm^2.s requires a relatively high power (300 MW range) and a small core volume (approximately 30 liters). This combination of power

and volume leads to a high power density which places increased demands on thermal hydraulic margins.

40870 **(NIIAR—27(708)) Analytical model for the process of deposit formation on fuel element surfaces in reactors with high-temperature organic coolants.** Gataullin, N.G.; Gavrilin, A.I.; Fedoseev, V.E.; Sulejmanov, A.S. (Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Dimitrovgrad (USSR)). 1986. 34p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. File Number DE87702847.

The analytical model for deposit formation in a reactor core with an organic coolant is described. The theory of colloidal particle deposition on the fuel surfaces, the particles being produced in the coolant due to radiation-thermal interaction, is used in model development. Effects of particle mass transfer, physical and chemical adsorption of them on the fuel surfaces, washing them off by the coolant, taking into account thermohydraulic characteristics of the core and physicochemical properties of it, are considered. Effect of direct coolant cooking at different stages of deposit formation is also taken into account. 22 references, 7 figures, 1 table.

2105 Power Reactors, Breeding

REFER ALSO TO CITATION(S) 40487, 40816, 40887, 40922, 40972, 40973, 40974, 40975, 40976, 40977, 40978, 40980, 40984, 41006, 41007, 41010, 41012, 41052

40871 **(ANL—87-17) Computerized operating procedures for shearing and dissolution of segments from LWBR [Light Water Breeder Reactor] fuel rods.** Osudar, J.; Deeken, P.G.; Graczyk, D.G.; Fagan, J.E.; Martino, F.J.; Parks, J.E.; Levitz, N.M.; Kessie, R.W.; Leddin, J.M. (Argonne National Lab., IL (USA)). May 1987. Contract W-31109-ENG-38. 203p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE87011008.

This report presents two detailed computerized operating procedures developed to assist and control the shearing and dissolution of irradiated fuel rods. The procedures were employed in the destructive analysis of end-of-life fuel rods from the Light Water Breeder Reactor (LWBR) that was designed by the Westinghouse Electric Corporation Bettis Atomic Power Laboratory. Seventeen entire fuel rods from the end-of-life core of the LWBR were sheared into 169 precisely characterized segments, and more than 150 of these segments were dissolved during execution of the LWBR Proof-of-Breeding (LWBR-POB) Analytical Support Project at Argonne National Laboratory. The procedures illustrate our approaches to process monitoring, data reduction, and quality assurance during the LWBR-POB work.

40872 **(CEA-IPSN-INFO—54) Fuel loading and divergence of the Creys-Malville power plant.** (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Inst. de Protection et de Surete Nucleaire). Sep 1985. 2p. (In French). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752276.

This paper reviews the main stages of the reactor fuelling and divergence phases while recalling the safety studies which have been necessary.

40873 **(CONF-870917—1) Concept for a small, colocated fuel cycle facility for oxide breeder fuels.** Burch, W.D.; Lerch, R.E.; Stradley, J.G. (Oak Ridge National Lab., TN (USA); Hanford Engineering Development Lab., Richland, WA (USA)). 1987. Contract AC05-84OR21400. 15p. NTIS, PC A02. File Number DE87010589.

From ANS/ENS international conference on fast breeder reactor systems: experience gained and path to economical power generation; Richland, WA, USA (13 Sep 1987).

As part of a United States Department of Energy (USDOE) program to examine innovative liquid-metal reactor (LMR) system designs over the past three years, the Oak Ridge National Laboratory (ORNL) and the Westinghouse Hanford Company (WHC) collaborated on studies of mixed oxide fuel cycle options. A principal effort was an advanced concept for a small integrated fuel cycle colocated with a 1300-MW(e) reactor station. The study provided a scoping design, capital and operating cost estimates, and a basis on which to proceed with implementation of such a facility if future plans so dictate. The facility integrated reprocessing, waste management, and refabrication functions in a single facility of nominal 35-t/year capacity utilizing the latest technology developed in fabrication programs at WHC and in reprocessing at ORNL. The concept was based on many years of work at both sites and extensive design studies of prior years.

40874 **(CONF-870917—2) An examination of reliability critical items in liquid metal reactors: An analysis by the Centralized Reliability Data Organization (CREDO).** Humphrys, B.L.; Haire, M.J.; Koger, K.H.; Manneschmidt, J.F.; Setoguchi, K.; Nakai, R.; Okubo, Y. (Oak Ridge National Lab., TN (USA); Power Reactor and Nuclear Fuel Development Corp., Oarai, Ibaraki (Japan). Oarai Engineering Center; Power Reactor and Nuclear Fuel Development Corp., Tokyo (Japan); Mitsubishi Research Inst., Tokyo (Japan)). 1987. Contract AC05-84OR21400. 12p. NTIS, PC A02. File Number DE87010598.

From ANS/ENS international conference on fast breeder reactor systems: experience gained and path to economical power generation; Richland, WA, USA (13 Sep 1987).

The Centralized Reliability Data Organization (CREDO) is the largest repository of liquid metal reactor (LMR) component reliability data in the world. It is jointly sponsored by the US Department of Energy (DOE) and the Power Reactor and Nuclear Fuel Development Corporation (PNC) of Japan. The CREDO data base contains information on a population of more than 21,000 components and approximately 1300 event records. A conservative estimation is that the total component operating hours is approaching 3.5 billion hours. Because data gathering for CREDO concentrates on event (failure) information, the work reported here focuses on the reliability information contained in CREDO and the development of reliability critical items lists. That is, components are ranked in prioritized lists from worst to best performers from a reliability standpoint. For the data contained in the CREDO data base, FFTF and JOYO show reliability growth; EBR-II reveals a slight unreliability growth for those components tracked by CREDO. However, tabulations of events which cause reactor shutdowns decrease with time at each site.

40875 **(FEI—1664) Kinetic effects in calculating local neutron-physical characteristics in fast reactor cores.** Suslov, I.R. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1985. 15p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702708.

The possibility of refinement of local neutron-physical characteristics of fast reactor cores by means of combination of calculations in diffusion approximation with kinetic equation solution in the isolated region is investigated. On the base of the analysis of the results of one-dimensional numerical experiments it is shown that for refining local neutron-physical characteristics of fast power reactors in many cases it is sufficient to use combination of the calculation in diffusion approximation over the reactor with kinetic equation solution in the isolated regions with boundary conditions from the calculation in diffusion approximation. Discordance in the results of such calculation with the results of kinetic equation solution over the reactor is approximately by an order less than the error of the initial calculation in diffusion approximation. The methods suggested can be carried over to the case of three-dimensional hexagonal or trigonal geometry. 3 references, 4 figures, 5 tables.

40876 **(FEI—1704) Calculational and experimental study of coolant flow regimes using the model of outlet chamber for the BN-600 type fast reactor.** Gorbunov, V.S.; Leonchuk, M.P.; Obmelyukhin, Yu.A.; Sivak, Z.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1985. 20p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702711.

Results of calculation-experimental study of coolant flow using the model of outlet chamber for the BN-600 type fast reactor are presented. Applicability of DUPT program realizing nonexplicit methods of numerical solution of hydrodynamics and heat transfer equations in multi-coupled regions with heterogeneous properties

for calculations of reactor real flows is studied and accuracy of numerically obtained rate, pressure and temperature patterns is determined. A good agreement of experimental data with calculation results according DUPT program is shown. Possibility of using DUPT program for calculation of coolant flow in emergency operation is confirmed. 3 references, 13 figures.

40877 **(FEI—1707) Hydraulic resistance of fast reactor fuel assemblies.** Zhukov, A.V.; Sorokin, A.P.; Titov, P.A.; Ushakov, P.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1985. 26p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. File Number DE87702713.

The results of the analysis of hydraulic resistance of smooth and ribbed rods bundles located in the triangular package are generalized. Rods ribbing is realized by wire-wrapping of rib over shell type. For this case as well as for smooth rods as compared with the available ones simple and more precise generalized dependences for hydraulic resistance coefficients in wide range of changing the determining parameters including tight packages of ribbed rods are obtained. 45 references, 13 figures, 2 tables.

40878 **(HEDL-SA—3471) Fracture toughness of irradiated stainless steel alloys.** Mills, W.J. (Hanford Engineering Development Lab., Richland, WA (USA)). Jan 1986. Contract AC06-76FF02170. 36p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87009974.

The postirradiation fracture toughness responses of Types 316 and 304 stainless steel (SS) wrought products, cast CF8 SS and Type 308 SS weld deposit were characterized at 427°C using J/sub R/-curve techniques. Fast-neutron irradiation of these alloys caused an order of magnitude reduction in J/sub c/ and two orders of magnitude reduction in tearing modulus at neutron exposures above 10 dpa, where radiation-induced losses in toughness appeared to saturate. Saturation J/sub c/ values for the wrought materials ranged from 28 to 31 kJ/m^2; the weld exhibited a saturation level of 11 kJ/m^2. Maximum allowable flaw sizes for highly irradiated stainless steel components stressed to 90% of the unirradiated yield strength are on the order of 3 cm for the wrought material and 1 cm for the weld. Electron fractographic examination revealed that irradiation displacement damage brought about a transition from ductile microvoid coalescence to channel fracture, associated with local separation along planar deformation bands. The lower saturation toughness value for the weld relative to that for the wrought products was attributed to local failure of ferrite particles ahead of the advancing crack which prematurely initiated channel fracture.

40879 **(LA—11051-T) Characterization of fuel swelling in helium-bonded carbide fuel pins.** Louie, D.L.Y. (Los Alamos National Lab., NM (USA)). Aug 1987. Contract W-7405-ENG-36. 290p. NTIS, PC A13/MF A01; 1; GPO Dep. File Number DE87012983.

This work is not only the first attempt at characterizing the swelling of (U,Pu)C fuel pellets, but it also represents the only detailed examinations on carbide fuel swelling at high fuel burnups (4 to 16 at. %). This characterization includes the contributions of fission gases, cracks and solid fission products to fuel swelling. Significantly, the contributions of fission gases and cracks were determined by using the image analysis technique (IAT) which allows researchers to take areal measurements of the irradiated fuel porosity and cracks from the photographs of metallographic fuel samples. However, because areal measurements for varying depths in the fuel pellet could not be obtained, the crack areal measurements could not be converted into volumetric quantities. Consequently, in this situation, an areal fuel swelling analysis was used. The macroscopic fission-gas induced fuel swelling (MAS) caused by fission-gas bubbles and pores > 1 μm was determined using the measured irradiated fuel porosity because the measuring range of IAT is limited to bubbles and pores >1 μm. Conversely, for fuel swelling induced by fission-gas bubbles < 1 μm, the microscopic fission-gas induced fuel swelling (MIS) was estimated using an areal fuel swelling model.

2106 Power Reactors, Auxiliary, Mobile, Package, And Transportable

REFER ALSO TO CITATION(S) 40933, 40987, 41077

40880 **(CONF-870102—14) Effects of space-dependent cross sections on core physics parameters for compact fast spectrum space power reactors.** Lell, R.M.; Hanan, N.A. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006985.

From 4. symposium on space nuclear power systems; Albuquerque, NM, USA (12 Jan 1987).

Effects of multigroup neutron cross section generation procedures on core physics parameters for compact fast spectrum reactors have been examined. Homogeneous and space-dependent multigroup cross section sets were generated in 11 and 27 groups for a representative fast reactor core. These cross sections were used to compute various reactor physics parameters for the reference core. Coarse group structure and neglect of space-dependence in the generation procedure resulted in inaccurate computations of reactor flux and power distributions and in significant errors regarding estimates of core reactivity and control system worth. Delayed neutron fraction was insensitive to cross section treatment, and computed reactivity coefficients were only slightly sensitive. However, neutron lifetime was found to be very sensitive to cross section treatment. Deficiencies in multigroup cross sections are reflected in core nuclear design and, consequently, in system mechanical design.

40881 **(HEDL-SA—3526) Preliminary site design for the SP-100 ground engineering test.** Cox, C.M.; Miller, W.C.; Mahaffey, M.K. (Hanford Engineering Development Lab., Richland, WA (USA)). Apr 1986. Contract AC06-76FF02170. 8p. (CONF-860810—49). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010728.

From Intersociety energy conversion engineering conference; San Diego, CA, USA (25 Aug 1986).

In November, 1985, Hanford was selected by the Department of Energy (DOE) as the preferred site for a full-scale test of the integrated nuclear subsystem for SP-100. The Hanford Engineering Development Laboratory, operated by Westinghouse Hanford Company, was assigned as the lead contractor for the Test Site. The nuclear subsystem, which includes the reactor and its primary heat transport system, will be provided by the System Developer, another contractor to be selected by DOE in late FY-1986. In addition to reactor operations, test site responsibilities include preparation of the facility plus design, procurement and installation of a vacuum chamber to house the reactor, a secondary heat transport system to dispose of the reactor heat, a facility control system, and postirradiation examination. At the conclusion of the test program, waste disposal and facility decommissioning are required. The test site must also prepare appropriate environmental and safety evaluations. This paper summarizes the preliminary design requirements, the status of design, and plans to achieve full power operation of the test reactor in September, 1990.

40882 **(PNL-SA—14372) Two-phase computer codes for zero-gravity applications.** Krotiuk, W.J. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1986. Contract AC06-76RL01830. 13p. (CONF-8610219—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE87002711.

From 33. annual meeting of the American Astronautical Society - aerospace: century 21; Boulder, CO, USA (27 Oct 1986).

This paper discusses the problems existing in the development of computer codes which can analyze the thermal-hydraulic behavior of two-phase fluids especially in low gravity nuclear reactors. The important phenomenon affecting fluid flow and heat transfer in reduced gravity is discussed. The applicability of using existing computer codes for space applications is assessed. Recommendations regarding the use of existing earth based fluid flow and heat transfer correlations are made and deficiencies in these correlations are identified.

40883 (SAND—86-1813C) The effect of operating temperature on open, multimegawatt space power systems. Edenburn, M.W. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 33p. (CONF-870102—26). NTIS, PC A03/MF A01; GPO Dep. File Number DE87011311.

From 4. symposium on space nuclear power systems; Albuquerque, NM, USA (12 Jan 1987).

This study addresses reactor powered and combustion powered multimegawatt, burst mode, space power systems to evaluate the effect turbine inlet temperature will have on their performance and mass. Both systems will provide power to space based antiballistic missile weapons that require hydrogen for cooling, and both use this hydrogen coolant as a working fluid or as a fuel for power generation. The quantity of hydrogen needed for weapon cooling increases as the weapon's cooling load increases and as weapon coolant outlet temperature decreases. Also, the hydrogen needed by the turbines in both power systems increases as turbine inlet temperature decreases. When weapon cooling loads are above 40% to 50% of weapon power and weapon coolant outlet temperature is below 300 K to 400 K, the weapon needs more hydrogen than the turbine in either the reactor or combustion powered systems using turbine inlet temperatures consistent with current material technology. There is therefore very little system mass reduction to be gained by operating a burst mode power system at a turbine inlet temperature above present material temperature limits unless the weapon's cooling load is below 40% to 50% or coolant outlet temperature is above 300 K to 400 K. Furthermore, the combustion system's mass increases as turbine inlet temperature increases because oxygen inventory increases with increased turbine inlet temperature.

40884 (SAND—87-0637C) A comparison of open and closed multimegawatt space power and weapon systems. Gallup, D.R.; Edenburn, M.W. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 12p. (CONF-870102—28). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012975.

From 4. symposium on space nuclear power systems; Albuquerque, NM, USA (12 Jan 1987).

One of the major questions that is being addressed at present by Strategic Defense Initiative's Multimegawatt Space Power Project is whether or not space weapon power systems must be closed, i.e., whether effluents from the systems are tolerable. If they are not tolerable, the major penalty that must be paid to close space systems is increased mass. Open systems remove waste heat by producing effluents, e.g., hot hydrogen gas. Closed systems require radiators, thermal storage masses, effluent storage, or refrigeration to remove waste heat. The mass penalty incurred by addition of these devices is so severe that the option of closing space power systems should be avoided, if at all possible. The mass penalty is even more severe if the weapon system itself must also be closed.

40885 (UCRL—95973) Gas-cooled reactor for space power systems. Walter, C.E.; Pearson, J.S. (Lawrence Livermore National Lab., CA (USA)). May 1987. Contract W-7405-ENG-48. 9p. (CONF-870804—19). NTIS, PC A02. File Number DE87011549.

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

Reactor characteristics based on extensive development work on the 500-MWt reactor for the Pluto nuclear ramjet are described for space power systems useful in the range of 2 to 20 MWe for operating times of 1 y. The modest pressure drop through the prismatic ceramic core is supported at the outlet end by a ceramic dome which also serves as a neutron reflector. Three core materials are considered which are useful at temperatures up to about 2000 K. Most of the calculations are based on a beryllium oxide with uranium dioxide core. Reactor control is accomplished by use of a burnable poison, a variable-leakage reflector, and internal control rods. Reactivity swings of 20% are obtained with a dozen internal boron-10 rods for the size cores studied. Criticality calculations were performed using the ALICE Monte Carlo code. The inherent high-temperature capability of the reactor design removes the reactor as a limiting condition on system performance. The low fuel inventories required, particularly for beryllium oxide reactors, make space power systems based on gas-cooled near-thermal reactors a lesser safeguard risk than those based on fast reactors.

2107 Regulation And Licensing

REFER ALSO TO CITATION(S) 40814, 40849, 40940, 40990, 41010, 41079, 41108

40886 (BNL-NUREG—39945) Generic safety insights for inspection of boiling water reactors. Higgins, J.C.; Taylor, J.H.; Fresco, A.N.; Hillman, B.M. (Brookhaven National Lab., Upton, NY (USA); Nuclear Regulatory Commission, Washington, DC (USA)). 1987. Contract AC02-76CH00016. 5p. (CONF-870601—20). NTIS, PC A02/MF A01. File Number DE87012117.

From Annual meeting of the American Nuclear Society; Dallas, TX, USA (7 Jun 1987).

As the number of operating nuclear power plants (NPP) increases, safety inspection has increased in importance. However, precisely what is important, and what is not important? What should one focus inspection efforts on. Over the last two years Probabilistic Risk Assessment (PR) techniques have been developed to aid in the inspection process. Broad interest in generic PRA-based methods has arisen in the past year, since only about 25% of the US nuclear power plants have completed PRAs, and also, inspectors want PRA-based tools for these plants. This paper describes the BNL program to develop generic BWR PRA-based inspection insights or inspection guidance designed to be applied to plants without PRAs.

40887 (CONF-870863—1) Safety and licensing for small and medium power reactors. Trauger, D.B. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87008597.

From Seminar on small and medium-sized nuclear reactors: safety and licensing issues; Lausanne, Switzerland (24 Aug 1987).

Proposed new concepts for small and medium power reactors differ substantially from traditional Light Water Reactors (LWRs). Although designers have a large base of experience in safety and licensing, much of it is not relevant to new concepts. It can be a disadvantage if regulators apply LWR rules directly. A fresh start is appropriate. The extensive interactions between industry, regulators, and the public complicates but may enhance safety. It is basic to recognize the features that distinguish nuclear energy safety from that for other industries. These features include: nuclear reactivity, fission product radiation, and radioactive decay heat. Small and medium power reactors offer potential advantages over LWRs, particularly for reactivity and decay heat.

40888 (EGG-M—36886) Update on the USNRC's Nuclear Plant Analyzer. Laats, E.T. (EG and G Idaho, Inc., Idaho Falls (USA)). 1987. Contract AC07-76ID01570. 12p. (CONF-870706—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012433.

From Summer computer simulation conference; Montreal, Canada (27 Jul 1987).

The Nuclear Plant Analyzer (NPA) is the US Nuclear Regulatory Commission's (NRC's) state-of-the-art nuclear reactor simulation capability. This computer software package integrates high fidelity nuclear reactor simulation codes such as the TRAC and RELAP5 series of codes with color graphics display techniques and advanced workstation hardware. An overview of this program was given at the 1984 Summer Computer Simulation Conference (SCSC), with selected topics discussed at the 1985 and 1986 SCSCs. Since the 1984 presentation, major redirections of this NRC program have been taken. The original NPA system was developed for operation on a Control Data Corporation CYBER 176 computer, technology that is some 10 to 15 years old. The NPA system has recently been implemented on Class VI computers to gain increased computational capabilities, and is now being implemented on super-minicomputers for use by the scientific community and possibly by the commercial nuclear power plant simulator community. This paper addresses these activities and related experiences. First, the Class VI computer implementation is discussed. The

trade-offs between gaining significantly greater computational speed and central memory, with the loss of performance due to many more simultaneous users is shown. Second, the goal of the super-minicomputer implementation is to produce a very cost-effective system that utilizes advanced (multi-dimensional, two-phase coolant) simulation capabilities at real wall-clock simulation times. Benchmarking of the initial super-minicomputer implementation is discussed. Finally, the technical and economic feasibility is addressed for implementing the super-minicomputer version of the NPA with the RELAP5 simulation code onto the Black Fox full scope nuclear power plant simulator.

40889 (IAEA-TECDOC—382, pp 115-132) **Authorization of nuclear installations in Spain.** Corretjer, L. (Junta de Energia Nuclear, Madrid, Spain). Oct 1986. (In Spanish). NTIS (US Sales Only), PC A16/MF A01. File Number DE87702732. (CONF-8410472—).

From Regional course on legislation and regulation of nuclear safety for Latin American countries; Montevideo, Uruguay (15 Oct 1984).

A survey is made of nuclear legislation and the nuclear regulatory structure. The national policy for the development of nuclear power and the control of, and constraints for, the licensing of nuclear facilities are briefly examined.

40890 **(NUREG—0304-Vol.12-No.1) Regulatory and technical reports (Abstract index journal): Compilation for first quarter 1987, January-March.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Publications Services). May 1987. 59p. NTIS, PC A04/MF A01 - GPO. File Number TI87900691.

This journal includes all formal reports in the NUREG series prepared by the NRC staff and contractors; proceedings of conferences and workshops; as well as international agreement reports. The entries in this compilation are indexed for access by title and abstract, secondary report number, personal author, subject, NRC organization for staff and international agreements, contractor, international organization, and licensed facility.

40891 **(NUREG—0750-Vol.24-No.6) Nuclear Regulatory Commission Issuances.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Publications Services). Dec 1986. 168p. NTIS, PC A08 - GPO. File Number DE87900840.

This report includes the issuances received during the specified period from the Commission (CLI), the Atomic Safety and Licensing Appeal Boards (ALAB), the Atomic Safety and Licensing Boards (LBP), the Administrative Law Judge (ALJ), the Directors' Decisions (DD), and the Denials of Petitions for Rulemaking (DPRM).

40892 **(NUREG—0800(6/87)) Standard Review Plan for the review of safety analysis reports for nuclear power plants: LWR edition.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Jun 1987. 2190p. NTIS, PC A99/MF A01 - GPO. File Number TI87900878.

The Standard Review Plan (SRP) is prepared for the guidance of staff reviewers in the Office of Nuclear Reactor Regulation in performing safety reviews of applications to construct or operate nuclear power plants. The principal purpose of the SRP is to assure the quality and uniformity of staff reviews and to present a well-defined base from which to evaluate proposed changes in the scope and requirements of reviews. It is also a purpose of the SRP to make information about regulatory matters widely available and to improve communication and understanding of the staff review process by interested members of the public and the nuclear power industry. The safety review is primarily based on the information provided by an applicant in a Safety Analysis Report (SAR). The SAR must be sufficiently detailed to permit the staff to determine whether the plant can be built and operated without undue risk to the health and safety of the public. The SAR is the principal document in which the applicant provides the information needed to understand the basis upon which this conclusion has been reached. The individual SRP sections address, in detail, who performs the review, the matters that are reviewed, the basis for review, how the review is accomplished, and the conclusions that are sought. The safety review is performed by 25 primary branches. One of the objectives of the SRP is to assign the review responsibilities to the various branches and to define the sometimes complex interfaces between them. Each SRP section identifies the branch that has the primary review responsibility for that section. In some review areas the primary branch may require support, and the branches that are assigned these secondary review responsibilities are also identified for each SRP section.

40893 **(NUREG—1214-Rev.1) Historical data summary of the Systematic Assessment of Licensee Performance.** Johnson, M.R.; Waterman, D.K. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Inspection Programs). Apr 1987. 66p. NTIS, PC A04/MF A01 - GPO. File Number TI87900578.

This report presents a history of Systematic Assessment of Licensee Performance (SALP) ratings for nuclear power plant facilities in operation and under construction. The SALP results are listed by NRC region in three sections: the most recent report, operating facilities, and facilities under construction. The historical data summary report has been prepared by the NRC Office of Inspection and Enforcement (IE). Information contained in this report has been updated to include those published SALP reports received before March 13, 1987.

40894 **(NUREG—1285) NRC [Nuclear Regulatory Commission] staff evaluation of the General Electric Company Nuclear Reactor Study ("Reed Report").** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Jul 1987. 60p. NTIS, PC A04/MF A01 - GPO. File Number TI87900906.

In 1975, the General Electric Company (GE) published a Nuclear Reactor Study, also referred to as "the Reed Report," an internal product-improvement study. GE considered the document "proprietary" and thus, under the regulations of the Nuclear Regulatory Commission (NRC), exempt from mandatory public disclosure. Nonetheless, members of the NRC staff reviewed the document in 1976 and determined that it did not raise any significant new safety issues. The staff also reached the same conclusion in subsequent reviews. However, in response to recent inquiries about the report, the staff reevaluated the Reed Report from a 1987 perspective. This re-evaluation, documented in this staff report, concluded that: (1) there are no issues raised in the Reed Report that support a need to curtail the operation of any GE boiling water reactor (BWR); (2) there are no new safety issues raised in the Reed Report of which the staff was unaware; and (3) although certain issues addressed by the Reed Report are still being studied by the NRC and the industry, there is no basis for suspending licensing and operation of GE BWR plants while these issues are being resolved.

40895 **(NUREG/CR—2000-Vol.6-No.6) Licensee event report (LER) compilation for month of June 1987.** (Oak Ridge National Lab., TN (USA). Nuclear Safety Information Center; Nuclear Regulatory Commission, Washington, DC (USA). Office for Analysis and Evaluation of Operational Data). Jul 1987. Contract AC05-84OR21400. 136p. (ORNL/NSIC—200-Vol.6-No.6). NTIS, PC A07/MF A01 - GPO. File Number TI87013101.

This monthly report contains Licensee Event Report (LER) operational information that was processed into the LER data file of the Nuclear Safety Information Center (NSIC) during the one month period identified on the cover of the document. The LERs, from which this information is derived, are submitted to the Nuclear Regulatory Commission (NRC) by nuclear power plant licensees in accordance with federal regulations. Procedures for LER reporting for revisions to those events occurring prior to 1984 are described in NRC Regulatory Guide 1.16 and NUREG-1061, Instructions for Preparation of Data Entry Sheets for Licensee Event Reports. For those events occurring on and after January 1, 1984, LERs are being submitted in accordance with the revised rule contained in Title 10 Part 50.73 of the Code of Federal Regulations (10 CFR 50.73 - Licensee Event Report System) which was published in the Federal Register (Vol. 48, No. 144) on July 26, 1983.

NUREG-1022, Licensee Event Report System - Description of Systems and Guidelines for Reporting, provides supporting guidance and information on the revised LER rule. The LER summaries in this report are arranged alphabetically by facility name and then chronologically by event date for each facility. Component, system, keyword, and component vendor indexes follow the summaries. Vendors are those identified by the utility when the LER form is initiated; the keywords for the component, system, and general keyword indexes are assigned by the computer using correlation tables from the Sequence Coding and Search System.

40896 **(NUREG/CR—4469-Vol.6) Nondestructive examination (NDE) reliability for inservice inspection of light water reactors: Semi-annual report, October 1986-March 1987.** Doctor, S.R.; Deffenbaugh, J.D.; Good, M.S.; Green, E.R.; Heasler, P.G.; Mart, G.A.; Simonen, F.A.; Spanner, J.C.; Taylor, T.T.; Van Fleet, L.G. (Pacific Northwest Lab., Richland, WA (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering). Jun 1987. Contract AC06-76RL01830. 62p. (PNL—5711-Vol.6). NTIS, PC A04/MF A01 - GPO. File Number TI87011627.

Evaluation and Improvement of NDE Reliability for Inservice Inspection of Light Water Reactors (NDE Reliability) Program at the Pacific Northwest Laboratory was established by the Nuclear Regulatory Commission to determine the reliability of current inservice inspection (ISI) techniques and to develop recommendations that will ensure a suitably high inspection reliability. The objectives of this program include determining the reliability of ISI performed on the primary systems of commercial light-water reactors (LWRs); using probabilistic fracture mechanics analysis to determine the impact of NDE unreliability on system safety; and evaluating reliability improvements that can be achieved with improved and advanced technology. A final objective is to formulate recommended revisions to ASME Code and Regulatory requirements, based on material properties, service conditions, and NDE uncertainties. The program scope is limited to ISI of the primary systems including the piping, vessel, and other inspected components. This is a progress report covering the programmatic work from October 1986 through March 1987.

40897 **(UNI-SA—184) Improving the effectiveness and efficiency of procedures.** Gibbs, J.M. (UNC Nuclear Industries, Inc., Richland, WA (USA)). 7 Oct 1986. Contract AC06-76RL01857. 7p. (CONF-870538—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE87003839.

From 34. international technical communication conference; Denver, CO, USA (10 May 1987).

This paper deals with specifications that are used for writing procedures for tasks for operating or maintaining an industrial facility.

2108 Economics

REFER ALSO TO CITATION(S) 40814, 41051

40898 **(ORNL—6368) Nuclear economics 2000: Deterministic and probabilistic projections of nuclear and coal electric power generation costs for the year 2000.** Williams, K.A.; Delene, J.G.; Fuller, L.C.; Bowers, H.I. (Oak Ridge National Lab., TN (USA)). Jun 1987. Contract AC05-84OR21400. 145p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87013359.

The total busbar electric generating costs were estimated for locations in ten regions of the United States for base-load nuclear and coal-fired power plants with a startup date of January 2000. For the Midwest region a complete data set that specifies each parameter used to obtain the comparative results is supplied. When based on the reference set of input variables, the comparison of power generation costs is found to favor nuclear in most regions of the country. Nuclear power is most favored in the northeast and western regions where coal must be transported over long distances; however, coal-fired generation is most competitive in the north central region where large reserves of cheaply mineable coal exist. In several regions small changes in the reference variables could cause either option to be preferred. The reference data set reflects the better of recent electric utility construction cost experience (BE) for nuclear plants. This study assumes as its reference case a stable regulatory environment and improved planning and construction practices, resulting in nuclear plants typically built at the present BE costs. Today's BE nuclear-plant capital investment cost model is then being used as a surrogate for projected costs for the next generation of light-water reactor plants. An alternative analysis based on today's median experience (ME) nuclear-plant construction cost experience is also included. In this case, coal is favored in all ten regions, implying that typical nuclear capital investment costs must improve for nuclear to be competitive.

40899 **(ORNL/TM—10195) Theory and evidence for using the economy-of-scale law in power plant economics.** Phung, D.L. (PAI Corp., Oak Ridge, TN (USA)). May 1987. Contract AC05-84OR21400. 59p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87011960.

This report compiles theory and evidence for the use of the economy-of-scale law in energy economics, particularly in the estimation of capital costs for coal-fired and nuclear power plants. The economy-of-scale law is widely used in its simplest form: cost is directly proportional to capacity raised to an exponent. An additive constant is an important component that is not generally taken into account. Also, the economy of scale is perforce valid only over a limited size range. The majority of engineering studies have estimated an economy of scale exponent of 0.7 to 0.9 for coal-fired plants and an exponent of 0.4 to 0.6 for nuclear plants in the capacity ranges of 400 to 1000 MWe. However, the majority of econometric analyses found little or no economy of scale for coal-fired plants and only a slight economy of scale for nuclear plants. This disparity is explained by the fact that economists have included regulatory and time-related costs in addition to the direct and indirect costs used by the engineers. Regulatory and time-related costs have become an increasingly larger portion of total costs during the last decade. In addition, these costs appeared to have either a very small economy of scale or to be increasing as the size of the power plant increased. We conclude that gains in economy of scale can only be made by reducing regulatory and time-related costs through design standardization and regulatory stability, in combination with more favorable economic conditions. 59 refs.

22 NUCLEAR REACTOR TECHNOLOGY

REFER ALSO TO CITATION(S) 40653

2201 Theory And Calculation

REFER ALSO TO CITATION(S) 40986, 41022, 41047, 41052

40900 **(CONF-8703156—1) Some discrepancies between experiments and calculations.** Thomas, J.T. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 25p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012540.

From Workshop on the influence of neutron spectra on experimental measurements; Tucson, AZ, USA (23 Mar 1987).

The results of several experiments and calculations are compared. The apparent discrepancies observed are evidence that the representations of neutron kinematics in the thermal and epi-thermal regions of the neutron energy spectrum are not correct in the computer codes used.

40901 **(CONF-8704113—2) Recalculation of a few bare plutonium critical arrays.** Dyer, H.R. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012527.

From Contractors nuclear criticality safety meeting; Las Vegas, NV, USA (27 Apr 1987).

This report presents the results of computations performed to investigate the discrepancy between previous calculation and critical experiments involving bare cubic arrays of Pu metal cylinders. It is shown that including all the support structure in the modeling is sufficient to account for earlier discrepancies. The pres-

ence of concrete walls, simulating the experimental cell, produced no statistically significant change in the array k/sub eff/.

40902 **(FEI—1671) Calculation of rod shift effect on the steady turbulent flow in rod bundles.** Gusev, N.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1985. 11p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702709.

The rate fields in central or peripheral cells of regular triangular rod lattice with shifted central rod are calculated. Stationary two-dimensional equation of the steady flow disregarding convective members is solved. Eddy viscosity coefficients are determined according to a Prandtl type model. The obtained rate fields for the lattice with the pitch-diameter ratio 1.35 and Re=35800 differ from those measured by 2%. Calculations for two different lattice models with the relative pitch 1.217 and $Re=2.7x10^5$ agree with the same accuracy. Plots of mean rate against the value of rod shift in two directions for side and central cells of triangular lattice are presented, the Re numbers being $2x10^3$-$2x10^5$. Calculations were carried out according to the program oriented on the regions with the boundaries of circle arcs and line segments. 7 references, 8 figures.

40903 **(FEI—1696) KOSMOS calculational complex for analysis of experiments with subcritical insertions.** Vasil'ev, Yu.Yu.; Gurin, V.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1985. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702710.

The fast-response one-dimensional calculational complex KOSMOS designed for analysis of multiregion model experiments with central subcritical insertions from fissile materials is described. The aim of the analysis is to refine the values of critical parameters and homogeneous one-dimensional full-scale systems from the material of insertion and errors of their prediction. The algorithm is based on a statistical approach to searching shifts in isertion micro- and macroconstants, which describe to the utmost the results of the considered set of critical model experiments. Complex evaluation by comparing the results of model experiments with insertions, containing metal highly enriched uranium, with the results of full-scale experiments has been carried out. KOSMOS complex permits to refine critical parameters of little-studied fissile materials of nuclear engineering based on the method of shift transfer. 15 references, 1 table.

40904 **(INIS-BR—650) Perturbation on diffusion problems in domain with interfaces.** Watson, F.V. (Santa Catarina Univ., Florianopolis (Brazil)). 1985. 5p. (In Portuguese). (CONF-8509403—2). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702759.

From 8. national congress on applied and computational mathematics; Florianopolis, Brazil (16 Sep 1985).

A perturbative type algorithm for the solution of linear diffusion equation at two dimensions, in domain with interfaces is presented. The perturbative scheme should be assembled in the weak formulation of diffusion equation, even if the strong solution exists, and when it is taken in terms superiors to first order, it should be calculated analytically, in one of the dimensions to avoid problems of slow convergence. (M.C.K.).

40905 **(JAERI—1302) Revised SRAC code system.** Tsuchihashi, K.; Ishiguro, Y.; Kaneko, K.; Ido, M. (Japan Atomic Energy Research Inst., Tokyo). Sep 1986. 293p. NTIS (US Sales Only), PC A13/MF A01. File Number DE87702609.

Since the publication of JAERI-1285 in 1983 for the preliminary version of the SRAC code system, a number of additions and modifications to the functions have been made to establish an overall neutronics code system. Major points are (1) addition of JENDL-2 version of data library, (2) a direct treatment of doubly heterogeneous effect on resonance absorption, (3) a generalized Dancoff factor, (4) a cell calculation based on the fixed boundary source problem, (5) the corresponding edit required for experimental analysis and reactor design, (6) a perturbation theory calculation for reactivity change, (7) an auxiliary code for core burnup and fuel management, etc. This report is a revision of the users manual which consists of the general description, input data requirements and their explanation, detailed information on usage, mathematics, contents of libraries and sample I/O. 102 references.

40906 **(JAERI-M—86-151) Vectorization of KENO IV code and an estimate of vector-parallel processing.** Asai, K.; Higuchi, K.; Katakura, J.; Kurita, Y. (Japan Atomic Energy Research Inst., Tokyo). Oct 1986. 60p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87702631.

The multi-group criticality safety code KENO IV has been vectorized and tested on FACOM VP-100 vector processor. At first the vectorized KENO IV on a scalar processor became slower than the original one by a factor of 1.4 because of the overhead introduced by the vectorization. Making modifications of algorithms and techniques for vectorization, the vectorized version has become faster than the original one by a factor of 1.4 and 3.0 on the vector processor for sample problems of complex and simple geometries, respectively. For further speedup of the code, some improvements on compiler and hardware, especially on addition of Monte Carlo pipelines to the vector processor, are discussed. Finally a pipelined parallel processor system is proposed and its performance is estimated.

40907 **(NRCN—567) Equivalence relations for the determination of neutron reaction rates in thermal reactor lattices.** Schneider, A. (Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev). Aug 1985. 135p. (In Hebrew). NTIS (US Sales Only), PC A07/MF A01. File Number DE87702852.

Equivalence relation formulations for the determination of average group cross sections in the energy range of resolved resonances are examined. The ordinary equivalence method relates heterogeneous lattices to equivalent homogeneous systems. The approximations and assumptions upon which the method is based are studied and it is found that the inaccuracy in group cross sections, calculated by this method, may reach 5% in the absence of overlap between resonances of different isotopes, and may exceed 10% in presence of resonance interference. The accuracy of the method may be improved by using properly adjusted, groupwise, Bell factors and intermediate resonance parameters, and by applying the intermediate resonance approximation also to the lattice moderator. Simple approximate methods for the assessment of the resonance interference effect on group cross sections, e.g. the method in the WIMS code, are quite inaccurate. An accurate treatment necessitates either the computation of correction factors from basic resonance data, or the use of group cross sections libraries with mixture dependence for the cross sections. An improved method for the calculation of average group cross sections is developed. It is based on an equivalence relation between a heterogeneous lattice and an isolated unit cell, unlike the ordinary equivalence which is between a lattice and an infinitely homogeneous mixture. The accuracy of this heterogeneous-heterogeneous equivalence is shown to be better then that of the ordinary heterogeneous-homogeneous equivalence: the inaccuracy of group cross sections, in the absence of resonance interference, is typically lower than 1%. This improved equivalence method, combined with a proper treatment of the interference effect, will enable a generation of group cross sections to withinjust a ?few percents error.

40908 **(SAND—86-2364C) The explicitly-interfaced method and the response matrix method: Two methods for the solution of the transport equation.** Rathkopf, J.A.; Lorence, L.J.; Martin, W.R. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Nuclear Fuel Div.; Sandia National Labs., Albuquerque, NM (USA); Michigan Univ., Ann Arbor (USA). Dept. of Nuclear Engineering). 1987. Contract AC04-76DP00789. 15p. (CONF-870424—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE87001730.

From American Nuclear Society international meeting on advances in reactor physics, mathematics and computation; Paris, France (27 Apr 1987).

The phase space finite element method when applied to the first order transport equation results in a matrix equation that can only be solved directly. While the direct solution procedure is competitive with more established transport methods for one-dimensional geometries, it is much too slow in two or more dimensions. This

summary presents two alternative implementations of the finite element method. Both reduce the size of the matrix to be solved by dividing the spatial domain into smaller regions, and both realize increased efficiency in multi-dimensional applications. Following brief derivations of the methods, computational results for both one-dimensional and two-dimensional applications will be presented and compared for the two distinct approaches.

40909 **(SAND—87-0735) A computer program to determine the specific power of prismatic-core reactors.** Dobranich, D. (Sandia National Labs., Albuquerque, NM (USA)). May 1987. Contract AC04-76DP00789. 69p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87012513.

A computer program has been developed to determine the maximum specific power for prismatic-core reactors as a function of maximum allowable fuel temperature, core pressure drop, and coolant velocity. The prismatic-core reactors consist of hexagonally shaped fuel elements grouped together to form a cylindrically shaped core. A gas coolant flows axially through circular channels within the elements, and the fuel is dispersed within the solid element material either as a composite or in the form of coated pellets. Different coolant, fuel, coating, and element materials can be selected to represent different prismatic-core concepts. The computer program allows the user to divide the core into any arbitrary number of axial levels to account for different axial power shapes. An option in the program allows the automatic determination of the core height that results in the maximum specific power. The results of parametric specific power calculations using this program are presented for various reactor concepts.

40910 **(ZfK—582) Neutron flux calculations for the Rossendorf research reactor in (hex)- and (hex,z)-geometry using SNAP-3D.** Koch, R.; Findeisen, A. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). Apr 1986. 84p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE87702869.

The multigroup neutron diffusion theory code SNAP-3D has been used to perform time independent neutron flux and power calculations of the 10 MW Rossendorf research reactor of the type WWR-SM. The report describes these calculations, as well as the actual reactor configuration, some details of the code SNAP-3D, and two- and three-dimensional reactor models. For evaluating the calculations some flux values and control rod worths have been compared with those of measurements.

40911 **(ZfK—583) To the accuracy of the calculation of sample reactivities in the SEG IV.** Heinzelmann, B. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). Apr 1986. 20p. (In German). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702870.

The uncertainties are investigated occurring with standard group diffusion codes in calculating the reactivities of samples which was oscillated in the system SEG IV. In spite of a system suitable selected (nearly constant influence function) difficulties arises in accurate calculation this part of the reactivity which can be originated to the scattering cross section of the sample. A 2 zone model and Wigner approximation is shown to be sufficient for taking into account self shielding in the iron samples dealt with. The error due to neglecting the change of shielding produced by the sample in his surrounding decreases from 10% to 1% if a more realistic geometrical model is used (around the sample a higher portion structural material as in a homogeneous mixture with uranium).

2202 Components And Accessories

REFER ALSO TO CITATION(S) 40938, 40958, 40963, 40979, 40981, 41000, 41001, 41052, 41063, 41068, 41298, 41300, 41304, 41306, 41310

40912 **(CONF-870812—1) Aging of concrete components and its significance relative to life extension of nuclear power plants.** Naus, D.J. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87005714.

From 9. SMIRT: international conference on structural mechanics in reactor technology; Lausanne, Switzerland (17 Aug 1987).

Nuclear power currently supplies about 16% of the US electricity requirements, with the percentage expected to rise to 20% by 1990. Despite the increasing role of nuclear power in energy production, cessation of orders for new nuclear plants in combination with expiration of operating licenses for several plants in the next 15 to 20 years results in a potential loss of electrical generating capacity of 50 to 60 gigawatts during the time period 2005 to 2020. A potential timely and cost-effective solution to the problem of meeting future energy demand is available through extension of the service life of existing nuclear plants. Any consideration of plant life extension, however, must consider the concrete components in these plants, since they play a vital safety role. Under the USNRC Nuclear Plant Aging Research (NPAR) Program, a study was conducted to review operating experience and to provide background that will lead to subsequent development of a methodology for assessing and predicting the effects of aging on the performance of concrete-based structures. The approach followed was in conformance with the NPAR strategy.

40913 **(CONF-870812—16) Current status of the WHAMS-3D code.** Belytscńko, T.; Kennedy, J.M. (Northwestern Univ., Evanston, IL (USA). Dept. of Civil Engineering; Argonne National Lab., IL (USA)). Mar 1987. Contract W-31109-ENG-38. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011472.

From 9. SMIRT: international conference on structural mechanics in reactor technology; Lausanne, Switzerland (17 Aug 1987).

The program WHAMS-3D is an explicit time integration program which can be used for frames, shells, plates and continua in three dimensions. Both material nonlinearities due to elasto-plastic behavior and geometric nonlinearities due to large displacements can be treated. The program has been developed to serve as a testbed for research into methods for nonlinear structural dynamics, but it can also be used for production calculations. The program is quite compact, so it can be coupled with other codes. The program employs a finite element format, so that is possesses considerable versatility in modeling complex shapes and boundary conditions. The element library consists of the following: quadrilateral and triangular plate-shell elements, a beam element, a spring element and a hexahedral continuum element. In addition, a rigid linkage is included which permits the efficient modeling of very stiff portions of a structure, such as the bottom ring of a core barrel. In a rigid linkage, the motion of a master node defines the motion of all slave nodes linked to the master node. This option is also useful for eccentrically connected elements where the modlines of the connected elements do not coincide, as for example, in stiffeners. Time integration is performed by the central difference method. The mass matrix is diagonal (lumped), so no equations need be solved. Different time steps can be used in different parts of the mesh.

40914 **(CONF-870812—21) Vibration testing of a 1/4-scale containment model.** Srinivasan, M.G.; Kot, C.A.; Hsieh, B.J. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011058.

From 9. SMIRT: international conference on structural mechanics in reactor technology; Lausanne, Switzerland (17 Aug 1987).

This paper presents programs for the validation of soil-structure interaction (SSI) analysis methods with data that include ground and structural response motions during natural earthquakes and structural response from low-level vibration tests. The primary source of the data is the 1/4-scale containment building situated in Lotung in a seismically active region of Taiwan. The analysis validation program involves blind predictions of site and structural response to the vibration test excitations and to a selected strong-motion seismic event, and the subsequent comparison of predictions with corresponding measurements. This paper focuses on the vibration testing of the model containment structure and the determination of its dynamic characteristics from the experimental data. The 1/4-scale reinforced concrete containment structure, built by EPRI in cooperation with Taiwan Power Company, is located within an

array of strong-motion seismographs, known as the SMART-1 array.

40915 **(CONF-8609233—1) Leakage flow-induced vibration of an unconstricted tube-in-tube slip joint.** Mulcahy, T.M. (Argonne National Lab., IL (USA)). Dec 1986. Contract W-31109-ENG-38. 22p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87004844.

From Vibration conference; Boston, MA, USA (27 Sep 1986).

The conditions are given for which the more flexible of two cantilevered, telescoping tubes conveying fluid can be self-excited by flow leaking from an unconstricted slip joint. Also, a physical explanation of the excitation mechanism is discussed, and a design rule to avoid the mechanism is presented. In addition, the results for the unconstricted slip joint are shown to be similar to those for slip joints having annulus constrictions at very short engagement lengths.

40916 **(DP-MS—86-219) Design base transient analysis using the real-time nuclear reactor simulator model.** Tien, K.K.; Yakura, S.J.; Morin, J.P.; Gregory, M.V. (Savannah River Lab., Aiken, SC (USA); Singer Co., Fairfield, NJ (USA)). 1987. Contract AC09-76SR00001. 33p. (CONF-870418—7). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011241.

From Topical meeting on anticipated and abnormal transients in nuclear power plants; Atlanta, GA, USA (12 Apr 1987).

A real-time simulation model has been developed to describe the dynamic response of all major systems in a nuclear process reactor. The model consists of a detailed representation of all hydraulic components in the external coolant circulating loops consisting of piping, valves, pumps and heat exchangers. The reactor core is described by a three-dimensional neutron kinetics model with detailed representation of assembly coolant and moderator thermal hydraulics. The models have been developed to support a real-time training simulator, therefore, they reproduce system parameters characteristic of steady state normal operation with high precision. The system responses for postulated severe transients such as large pipe breaks, loss of pumping power, piping leaks, malfunctions in control rod insertion, and emergency injection of neutron absorber are calculated to be in good agreement with reference safety analyses. Restrictions were imposed by the requirement that the resulting code be able to run in real-time with sufficient spare time to allow interfacing with secondary systems and simulator hardware. Due to hardware set-up and real plant instrumentation, simplifications due to symmetry were not allowed. The resulting code represents a coarse-node engineering model in which the level of detail has been tailored to the available computing power of a present generation super-minicomputer. Results for several significant transients, as calculated by the real-time model, are compared both to actual plant data and to results generated by fine-mesh analysis codes.

40917 **(EGG-M—17686) INEL/USNRC pipe damping experiments and studies.** Ware, A.G. (EG and G Idaho, Inc., Idaho Falls (USA)). Aug 1987. Contract AC07-76ID01570. 19p. (CONF-870812—28). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012431.

From 9. SMIRT: international conference on structural mechanics in reactor technology; Lausanne, Switzerland (17 Aug 1987).

Since the previous paper on this subject presented at the 8th SMiRT Conference, the Idaho National Engineering Laboratory (INEL) has conducted further research on piping system damping for the United States Nuclear Regulatory Commission (USNRC). These efforts have included vibration tests on two laboratory piping systems at response frequencies up to 100 Hz, and damping data calculations from both of these two systems and from a third laboratory piping system test series. In addition, a statistical analysis was performed on piping system damping data from tests representative of seismic and hydrodynamic events of greater than minimal excitation. The results of this program will be used to assist regulators in establishing suitable damping values for use in dynamic analyses of nuclear piping systems, and in revising USNRC Regulatory Guide (RG) 1.61.

40918 **(EPRI-NP—4997) Natural versus artificial aging of nuclear power plant components: Interim report.** Shaw, M.T. (Connecticut Univ., Storrs (USA). Inst. of Materials Science; Electric Power Research Inst., Palo Alto, CA (USA)). Dec 1986. 76p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920302.

This project concerns the aging of polymeric materials in nuclear reactor containments. Specifically it is designed to look for differences between the aging processes in the containment environment and those occurring during accelerated testing as used for qualification of electrical components. The first phase of the project involved the selection and acquisition of test specimens, their preparation for placement in the containment, and the selection of plants and locations for the specimens. In addition, the report describes the methods for monitoring the radiation and temperature levels at each site, and the plans for removal and testing of the specimens for degradation in physical properties. Tentative procedures for the accelerated aging and testing of identical specimens are also outlined.

40919 **(EPRI-NP—5017) Crevice corrosion of support alloys in the secondary environments of nuclear steam generators: Supplemental report: Final report.** McKubre, M.C.H.; Leach, S.C. (SRI International, Menlo Park, CA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Mar 1987. 153p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920303.

The extent to which a reduction in corrosion rate is possible by substituting alloys for carbon steel support plates in steam generators was estimated in this project. Galvanic corrosion currents were measured across crevices formed by alloy 600 tubes in support plate holes. Active galvanic cells are found between support alloys in crevices and alloy 600 tubes, both inside and outside the crevice. Both are important. The outside cell is driven by oxygen or oxidants in the bulk water. The effect of this external cell is to concentrate salt and acid in the crevice region, which may initiate aggressive damage due to the inside galvanic couple. By reducing the aggressive effect of oxidants outside the crevice, hydrazine can minimize the outside galvanic couple, and thus prevent the formation by electrochemical means of concentrated electrolyte condition in the crevice. The concentration of salts as well as pH are important factors in determining the galvanic corrosion rate inside the crevice. Concentrated seawater of near neutral pH was more corrosive than 10^{-3} normal sulfuric and hydrochloric acids or Susquehanna River water when pumped directly into the crevices. Compared to carbon steel, the corrosion rates were reduced about two- or fourfold for types 405 and 409 stainless steels and were reduced more than an order of magnitude by types 347 stainless steel and alloy 800. Acid chlorides were more corrosive to types 405 and 409 stainless steels than acid sulfates.

40920 **(EPRI-NP—5120) Intergranular attack or corrosion in a once-through model steam generator: Final report.** Barna, J.L.; Sarver, L.W. (Babcock and Wilcox Co., Alliance, OH (USA). Research and Development Div.; Electric Power Research Inst., Palo Alto, CA (USA)). Jul 1987. 201p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920498.

Faulting the feedwater for a 19-tube, model steam generator with 10 ppM of caustic once a week produced widespread shallow 25 to 75 micrometers (1 to 3 mils) intergranular attack (IGA) on alloy 600 tubes and an axial tube rupture at the steam-water interface after 4.8 years. An extensive investigation of the IGA damage found little correlation with major test variables beyond the indication that mill-annealed tubing was more susceptible to attack than stress-relieved tubing. The most likely cause of the tube rupture was caustic that concentrated to high levels in a porous scale on the tube at the liquid-vapor interface where there was a high available superheat. Nondestructive examination (NDE) eddy current probes underestimated the depth of IGA and were not sensitive to circumferential cracks less than 152 micrometers (6 mils) deep that were above and below the roll transition zones of tubes in the tubesheet.

40921 **(EPRI-NP—5182) Stress corrosion cracking of A471 turbine disk steels: Effects of dissolved oxygen and carbon dioxide in high-purity water: Final report.** Eiselstein, L.E.; Caligiuri, R.D. (SRI International, Menlo Park, CA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jun 1987. 141p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920477.

Experiments were performed to determine the effect of dilute impurities in high purity water on the rate of initiation and growth of stress corrosion cracks in NiCrMoV steels. 3.5 NiCrMoV steels of commercial quality, high purity, and high purity with intentionally added tramp elements were investigated. Dissolved oxygen and carbon dioxide were the primary water impurities investigated. The tests were conducted on constant load, smooth bar tensile specimens of the NiCrMoV steels in flowing 160°C high purity water containing various dilute levels of impurities. It was determined that the initiation rate is very sensitive to changes in dissolved oxygen content; the peak initiation rate are achieved between 20 and 80 ppB dissolved oxygen. The initiation rate is less sensitive to dissolved CO_2 content. The crack growth rate in high purity water is only weakly dependent on dissolved O_2 and CO_2. This work shows that the crack growth rate is strongly dependent on the yield strength (and therefore the microstructure that develops as a result of tempering) of the turbine disc alloy, whereas the initiation rate is only weakly dependent on material yield strength. In addition, crack growth rates decrease as grain sizes are decreased. In general, crack growth rates are very slow (less than 10^{-10} m/s) in these dilute environments in materials with yield strengths below 690 Mpa (100 ksi). The results of these experiments indicate that a hydrogen-assisted process may be an important cracking mechanism in these alloys in these dilute environments. Implication of a hydrogen-assisted mechanism could have important consequences in the design and selection of turbine disc alloys.

40922 **(EUR—10592) Benchmark study of shear buckling of a cylindrical vessel.** Dostal, M.; Austin, N.M.; Peano, A.; Combescure, A.; Bastien, R.; Carnoy, E.G. (Commission of the European Communities, Luxembourg). 1986. 139p. NTIS (US Sales Only), PC A07/MF A01. File Number DE87752289.

The possibility of a buckling failure of the primary vessel subjected to seismic excitation has been considered, by all major designers of loop and pool type liquid metal cooled fast breeder reactors. The problem is particularly onerous in this type of reactor due to their large size, coupled with small wall thicknesses. This report details the results of the first phase in a joint European code validation exercise on the static shear buckling behaviour of thin, low aspect ratio stainless steel cylinders. Linear and non-linear finite element analyses were performed by four organizations using three different computer codes, i.e. NNC (UK)-ABAQUS, ISMES (Italy)-ABAQUS, CEA (France)-BILBO/INCA and NOVA-TOME (France)-NOVNL. The computed results were compared directly with experimental results. It was discovered that refined finite element models were essential if accurate buckling loads were to be calculated. Buckling analyses in 3D were therefore computationally expensive and 2D analyses, where applicable, proved an useful alternative. Traditional linear (Euler) bifurcation analysis seriously over-estimated the buckling loads by around 50%. Extrapolation techniques can however be used to reduce this discrepancy. Elasto-plastic bifurcation analysis predicted conservative buckling loads close to the experimental value. Non-linear, large displacement analyses were performed on the vessel. The effect of geometrical imperfections in the vessel was considered. These analyses all over-estimated the experimental buckling load by 10%-25% and appeared to be largely insensitive to the initial imperfection size. Each of the codes appeared to predict reasonably well the final buckled geometry although the analytical load-deflection estimate did not agree exactly with the experiment.

40923 **(FEI—1662) Temperature regime and gas motion structure in vertical transmit channels of a nuclear power facility.** Matyushina, S.A.; Opanasenko, A.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1985. 13p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702707.

Results of experimental and numerical study of motion stucture, temperature regime and mass transfer in vertical channels of 40, 80, 160, 275 mm in diameter, connecting a heated gas cavity filled with argon, air or nitrogen with the environment depending on the channel relative length (l/d=0-20), the temperature difference along its length (ΔT=0-350 deg C), boundary conditions on the external wall are presented. Temperature regime in the lower part of channels is characterized by a high temperature gradient in the vertical direction and large-scale low-frequency (below 0.1 Hz) random temperature fluctuations with the amplitude attaining 40 % of general temperature difference along the length. Mass transfer in transmit channels on external walls is approximately proportional to diameter, the relative lengths, temperature difference and boundary conditions being different. Stagnant gas plug taking place at l/d>10 has a determining influence on mass transfer. It is linearly increased by the temperature gradient growth along the axis. The relative lengths being small, the gas plug being absent, mass transfer growth rate is much higher by increase of the temperature gradient. 4 references, 11 figures.

40924 **(NUREG/CR—4765) MXS cross-section preprocessor user's manual.** Parker, F.; Ishikawa, M.; Luck, L. (Los Alamos National Lab., NM (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Accident Evaluation). Mar 1987. Contract W-7405-ENG-36. 53p. (LA—10856-M). NTIS, PC A04/MF A01 - GPO. File Number TI87006256.

The MXS preprocessor has been designed to reduce the execution time of programs using isotopic cross-section data and to both reduce the execution time and improve the accuracy of shielding-factor interpolation in the SIMMER-II accident analysis program. MXS is a dual-purpose preprocessing code to: (1) mix isotopes into materials and (2) fit analytic functions to the shelf-shielding data. The program uses the isotope microscopic neutron cross-section data from the CCCC standard interface file ISOTXS and the isotope Bondarenko self-shielding data from the CCCC standard interface file BRKOXS to generate cross-section and self-shielding data for materials. The materials may be a mixture of several isotopes. The self-shielding data for the materials may be the actual shielding factors or a set of coefficients for functions representing the background dependence of the shielding factors. A set of additional data is given to describe the functions necessary to interpolate the shielding factors over temperature.

40925 **(NUREG/CR—4931) Response to centrifugal and axi-vane blowers to large pressure transients.** Gregory, W.S.; Smith, P.R. (Los Alamos National Lab., NM (USA); Nuclear Regulatory Commission, Rockville, MD (USA). Div. of Risk Analysis). Jun 1987. Contract W-7405-ENG-36. 95p. (LA—11019-MS). NTIS, PC E05/MF A01 - GPO. File Number TI87011379.

Includes 5 sheets of 24x reduction microfiche.

The effect of large pressure pulses on the operation of centrifugal and axi-vane blowers of the types found in ventilation systems used in the mining and nuclear industries was investigated using the Los Alamos National Laboratory/New Mexico State University fluid dynamics test facility. Three blowers were tested for both quasi-steady and transient pressures: a 24-in. and a 12-in. centrifugal blower and a 33-in. axi-vane blower were subjected to pressure pulses at their exhaust and inlet, which caused backflow and outrunning flow, respectively. Performance curves were obtained for the first, second, and fourth quadrants.

40926 **(ANL-Trans—87-7) Erosion corrosion in water-steam systems: Causes and countermeasures.** Heitmann, H.G.; Kastner, W. Translated from *VGB Kraftwerkstechnik ;* **65**: No. 1, 64-70(Jan 1985). Contract W-31109-ENG-38. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87012685.

For the purpose of a better understanding of erosion corrosion, the physical and chemical principles will be summarized briefly. Then results obtained at KWU in the BENSON test section in tests on test specimens in single-phase flow of fully demineralized water will be presented. The experimental studies provide information about the most important influencing parameters. These include flow rate, fluid temperature and water quality (pH value and

oxygen content). In addition, the resistance of various materials is compared, and the resistance of magnetite coatings to erosion corrosion is investigated. Furthermore, tests are presented that will show the extent to which erosion corrosion in power plants can be influenced by chemical measures.

2203 Fuel Elements

REFER ALSO TO CITATION(S) 40901, 40946, 40947, 40952, 40953, 41066

40927 **(CONF-861185—5) Conversion and standardization of university reactor fuels using low-enrichment uranium: Plans and schedules.** Young, H.H.; Brown, K.R.; Matos, J.E. (USDOE, Washington, DC; Argonne National Lab., IL (USA)). 1986. Contract W-31109-ENG-38. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87004925.

From Reduced Enrichment for Research and Test Reactors (RERTR) program international meeting; Gatlinburg, TN, USA (3 Nov 1986).

The highly-enriched uranium (HEU) fuel used in twenty United States university reactors can be viewed as contributing to the risk of theft or diversion of weapons-useable material. To minimize this risk, the US Nuclear Regulatory Commission issued its final rule on "Limiting the Use of Highly Enriched Uranium in Domestically Licensed Research and Test Reactors," in February 1986. This paper describes the plans and schedules developed by the US Department of Energy to coordinate an orderly transition from HEU to LEU fuel in most of these reactors. An important element in the planning process has been the desire to standardize the LEU fuels used in US university reactors and to enhance the performance and utilization of a number of these reactors. The program is estimated to cost about $10 million and to last about five years.

40928 **(ECN—195) Application of noise analysis in fuel-pin research.** Tuerkcan, E.; Vries, J.E. de. (Netherlands Energy Research Foundation, Petten). Jan 1987. 38p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87702670.

In the Petten High Flux Reactor fuel pin irradiations have been carried out as part of a transient overpower experiment, HFR-TOP. The data-acquisition system and analysis methods are described and some results from the TOP04 and TOP05 irradiations are presented. A simplified dynamic fuel-pin model has been applied and the experimental data are compared with some outcomes of the model calculations. The heat transfer characteristics are determined using the transfer function between the neutron flux fluctuations (assumed to be proportional to those of the heat source) and the temperature fluctuations. A good agreement has been reached and the experimental response functions can be interpreted in terms of the thermal fuel-pin characteristics. It is shown how noise-analysis contributes to the analysis of the fuel-pin behaviour under operating conditions. 7 references, 9 figures, 1 table.

40929 **(EUR—10345) Fission Product Source Term chemical form and release of fission products at elevated temperature.** Andriesse, C.D. (Commission of the European Communities, Luxembourg). 1985. 36p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87752294.

From experimental release data at temperatures above 1500/ sup 0/C, a theory is derived for the fission products release. The release is described in terms of intragranular diffusion, driven by small gradients of concentration and temperature. About one half of the fission product atoms diffuse interstitially with a relatively low activation energy; as they are larger than the interstitial holes they diffuse with a positive excess entropy, which is a strong function of their size. The other half diffuses substitutionally with a relatively high activation energy. Other transport processes, like diffusion along grain boundaries and cracks, are faster than this intragranular diffusion and thus do not limit the release. It is speculated that all fission products are released as single atoms, except the lanthanides, the ytttrium, the zirconium and the niobium. The use of such a theory might be, e.g. that some deliberately introduced disorder in the UO/sub 2/-matrix could reduce the excess entropy of the diffusion and thereby possibly reduce the release of large interstitial atoms. 25 refs.

40930 **(GA-A—18780) TFE Verification Program: Semi-annual report for the period ending March 31, 1987.** (GA Technologies, Inc., San Diego, CA (USA); USDOE San Francisco Operations Office, Oakland, CA). Apr 1987. Contract AC03-86SF16298. 114p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87010825.

The objective of the TFE program is to demonstrate the technological readiness of a thermionic fuel element suitable for use as the basic element in a thermionic reactor with electric power output in the .5 to 5.0 MWe range, with a full-power life of 7 years. This report summarizes the technical results obtained in this program. Information presented here contains evaluated test data, designs, and experimental results. (JDB)

40931 **(HEDL-SA—3447-FP) High temperature transient deformation of mixed oxide fuels.** Slagle, O.D. (Hanford Engineering Development Lab., Richland, WA (USA)). 26 Mar 1986. Contract AC06-76FF02170. 18p. (CONF-860418—21). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87004093.

From 88. annual meeting of the American Ceramic Society; Chicago, IL, USA (27 Apr 1986).

The purpose of this paper is to present recent experimental results on fuel creep under transient conditions at high temperatures. The effect of temperature, stress, heating rate, density and grain size were considered. An empirical formulation is derived for the relationship between strain, stress, temperature and heating rate. This relationship provides a means for incorporating stress relief into the analysis of fuel-cladding interaction during an overpower transient. The effect of sample density and initial grain size is considered by varying the sample parameters. Previously derived steady-state creep relationships for the high temperature creep of mixed oxide fuel were combined with the time dependency of creep found for UO_2 to calculate a transient creep relationship for mixed oxide fuel. These calculated results were found to be in good agreement with the measured high temperature transient creep results.

40932 **(ZfK—603) Failure analysis for WWER-fuel elements.** Boehmert, J.; Huettig, W. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). Oct 1986. 10p. (In German). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702878.

If the fuel defect rate proves significantly high, failure analysis has to be performed in order to trace down the defect causes, to implement corrective actions, and to take measures of failure prevention. Such analyses are work-consuming and very skill-demanding technical tasks, which require examination methods and devices excellently developed and a rich stock of experience in evaluation of features of damage. For that this work specifies the procedure of failure analyses in detail. Moreover prerequisites and experimental equipment for the investigation of WWER-type fuel elements are described.

2204 Control Systems

REFER ALSO TO CITATION(S) 41002, 41004, 41005

40933 **(CONF-870102—15) Interaction of the control system with core nuclear design for fast spectrum space power reactors.** Lell, R.M.; Hanan, N.A. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 23p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006987.

From 4. symposium on space nuclear power systems; Albuquerque, NM, USA (12 Jan 1987).

Generic features of the interaction between core nuclear and mechanical designs and reactor control system design for compact fast spectrum space power reactors have been examined. Reactivity worths of various control concepts were evaluated for representative fast spectrum cores. In addition, special characteristics of each control concept that significantly affect core nuclear and mechanical design were considered. Ex-core control methods based on reflector control and in-core control devices such as control rods lead to divergent core designs and to different types of design problems.

Total control worth of ex-core control devices is limited and is strongly dependent on core size. Reflector control also results in unfavorable radial power shifts, but ex-core control does avoid unnecessary reactor vessel penetrations. Control rods have characteristics essentially opposite to those of ex-core devices. Design demands on the primary control system are shown to be reduced by including a slow-acting secondary system based on in-core dispersed poison.

40934 **(DOE/NE/37959—4) Signal validation in nuclear power plants: Progress report No. 3.** Kerlin, T.W.; Upadhyaya, B.R. (Tennessee Univ., Knoxville (USA). Dept. of Nuclear Engineering). 24 Jun 1987. Contract AC02-86NE37959. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011870.

This report summarizes the progress in the Signal Validation Project. Specifically, the advances made in several of the modules have been described. Some of these modules are now ready for preliminary implementation using plant operational data. Arrangements with Northeast Utilities Service Company (NUSCO) for transferring several sets of plant operational data from Millstone-3 PWR have been made in preparation for this phase of the project.

40935 (EPRI-CS/NP—3016-Vol.4B, pp 2.67-2.87) **Use of MMS for control system simulation and tuning.** Sudduth, A.L.; Watkins, S.T. (Duke Power Co., Charlotte, NC). Apr 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920392. (CONF-8409396—Vol.4B).

From Workshop on Modular Modeling System (MMS); New Orleans, LA, USA (26 Sep 1984).

A survey is made of several methods by which the gain settings of conventional cascade controllers may be determined through knowledge of the controlled process dynamics. The methods are found to be based on determination of the process open loop step response and are, therefore, easily implemented through process simulation, based on the desired closed loop response criterion. The simulation may then be used to verify proper closed loop response. The Modular Modeling System (MMS) is used in an example to illustrate application of the method to level control in a series of cascaded feedwater heaters. It is concluded that simulation may be used both to select and verify proper controller design and to determination controller gain settings for initial process startup.

40936 (EPRI-CS/NP—3016-Vol.4B, pp 3.45-3.54) **Computer aided engineering analysis of power plant control systems.** Hefler, J.W.; Edlinger, J.K.; Kelley, R.E. (Bechtel Power Corp., San Francisco, CA). Apr 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920392. (CONF-8409396—Vol.4B).

From Workshop on Modular Modeling System (MMS); New Orleans, LA, USA (26 Sep 1984).

One reason for developing MMS was to permit modeling the behavior of a plant under possible extreme transients and then developing control strategies to cope with them. This has been done on a generic design of a 1200 MW Westinghouse PWR. The plant was modeled using conventional control approaches. Selected transients were then simulated, including the effect of assumed operating procedures. These simulations disclosed that the initial control strategy resulted in a loss of pump NPSH and excessive rates of component temperature change. By iteratively testing a series of improvements with the MMS, a satisfactory control strategy was developed.

40937 **(NUREG/CR—4626-Vol.2) Improving the reliability of open-cycle water systems: Application of biofouling surveillance and control techniques to sediment and corrosion fouling at nuclear power plants.** Johnson, K.I.; Neitzel, D.A. (Pacific Northwest Lab., Richland, WA (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Safety Review and Oversight). Mar 1987. Contract AC06-76RL01830. 45p. (PNL—5876-Vol.2). NTIS, PC A03/MF A01 - GPO. File Number TI87006795.

Biofouling surveillance and control techniques are evaluated for their applicability to sediment and corrosion fouling and suggestions are given to improve their effectiveness. Alternate techniques to better detect and control sedimentation and corrosion are also evaluated. Environmental conditions that allow biofouling, sedimentation, and corrosion to occur are summarized. A correlation between sediment and corrosion is identified and the causes are described. Environmental regulations, especially those in the Clean Water Act of 1977, are reviewed to identify those that may limit or prevent the use of surveillance and control techniques described in this report. Flow velocity is the major design factor that determines whether or not biofouling, sedimentation, and corrosion will occur. Monitoring flow conditions can provide early warning of conditions that will allow fouling to occur. Visual inspection is the most common and most effective technique for identifying the cause and extent of fouling in the open-cycle water system. Most biofouling control techniques in current use are not effective against sediment and corrosion. Frequent, high-velocity flushing of cooling loops may effectively remove sediment and reduce under-sediment corrosion. Alternate biocide treatments such as targeted chlorination or the use of ozone or 2,2-dibromo-3-nitrilo propionamide (DBNPA) may also be effective in reducing under-sediment corrosion.

40938 **Weld monitor and failure detector for nuclear reactor system.** Sutton, H.G. Jr. (to Dept. of Energy, Washington, DC). US Patent 4,675,146. 23 Jun 1987. Filed date 21 Oct 1983. vp.

This patent describes a detection system for monitoring the integrity of inaccessible weld means throughout the life of a reactor system and providing a responsive signal indicative of weld failure. The nuclear reactor system includes a steel nuclear reactor vessel having an outer wall surface and an inner wall surface and reactor vessel structural support means projecting inwardly from the vessel inner wall surface. Reactor core means is retained within the reactor vessel. Heat transfer coolant means which during reactor operation flows upwardly through the reactor core means under pressure is greater than the pressure of the atmosphere exteriorly of the reactor vessel. A steel reactor core support structure supports the reactor core within the reactor vessel, and circumferential weld means affixing the reactor core support structure to the reactor vessel structural support means. The detection system comprises: weld integrity monitor means comprising small aperture means opening from the outer wall surface of the reactor vessel and extending through the wall of the reactor vessel and through the inwardly projecting reactor vessel structural support means and completely through the circumferential weld means. All portions of the aperture means are normally sealed from the coolant-means-containing environment within the reactor vessel; and detecting means positioned exteriorly of the reactor vessel detects the egress of any of the coolant means from the reactor vessel via the aperture means. Coolant means egress is indicative of the failure of the circumferential weld means.

2205 Environmental Aspects

REFER ALSO TO CITATION(S) 40964, 40983, 41019, 41033, 41053, 41071

40939 **(BMU—1986-135) OLDES - an on-line dose evaluation system that can be integrated into the remote monitoring system of nuclear power stations for additional monitoring and prognostic assessment in case of major accidental activity release.** Witt, H. de; Brenk, H.D.; Kruschel, K.P.; Knaup, A.G. (Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.)). 1986. 228p. (In German). NTIS, PC E15; Available from NTIS as TIB/B87-09389.

Schriftenreihe Reaktorsicherheit und Strahlenschutz. Ergebnisberichte, Untersuchungen, Studien, Gutachten.

Remote monitoring systems are an inherent part of the environmental surveillance installations of most commercial LWR power plants in the FRG. The systems are designed to cover routine and accident situations. They provide meteorological data, gross effluent dose rates, and dose measurements at approximately 25 locations in the vicinity of the plant in time steps of 10 minutes. Based on such a network, an attempt has been made to develop an on-line dose evaluation system (OLDES) as a tool to aid decision making processes in case of major accidental releases. On-line, here means that the software package directly includes the measurements at the monitoring stations in order to adjust the dose compu-

tations to the measurements in time steps of 10 minutes. In this way the system yields the best possible bases, both for actual diagnosis of radiation exposure, and for dose projections. The software package uses a Gaussian puff trajectory model to simulate atmospheric dispersion and deposition of radionuclides. It includes 'cloud- and ground-shine irradiation' and allows for changing weather conditions without exceeding the limits of real time calculation. Preliminary tests of the software package revealed reasonable semioperational performance.

40940 **(CONF-8611145—1) Preparation of environmental reports and impact statements for nuclear power plants.** Tsai, Y.H. (Argonne National Lab., IL (USA)). 1986. Contract W-31109-ENG-38. 28p. NTIS, PC A03/MF A01; GPO Dep. File Number DE87004750.

From 11. modern engineering and technology (METS-86); Taitei, Taiwan (17 Nov 1986).

Considerable first-hand experience has accumulated during the past decade in the United States regarding the preparation of environmental reports (ER) and environmental impact statements (EIS) for nuclear power plants. The US Nuclear Regulatory Commission (USNRC), which is responsible for regulating the construction and operation of nuclear power plants, is required under the National Environmental Policy Act to prepare an EIS for each plant. To obtain information essential to the EIS, the USNRC requires that each power company submit an ER. This paper focuses on the interrelationships of the two environmental documents and discusses the environmental review process and the environmental laws and regulations related to the licensing of nuclear power plants. It also describes the format and content, environmental issues, data requirements, and impact assessment methodologies for preparation of the ER and EIS. Problems associated with preparing the EIS are presented, with particular emphasis on the problems and methodologies associated with evaluating environmental costs and benefits.

40941 **(FEI—1706) DUPT program for calculating heat and mass transfer in one- and multi-coupled regions with heterogeneous medium properties.** Leonchuk, M.P.; Sivak, Z.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1985. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702712.

Description of DUPT program for calculating heat and mass transfer in multi-coupled regions with variable medium properties is presented. Hydrodynamics equations in Bussinesk approximation are solved using nonexplicit numerical methods in rate variables for one-coupled regions and in pressure rate variables for multi-coupled ones. The heat transfer equation is solved with 1.2 and 3 order boundary conditions. An example of using program for calculating water flow in the model of outlet chamber for the BN-600 type fast reactor is presented. 3 references, 6 figures.

40942 **(IAEA-TECDOC—403) Siting of research reactors.** (International Atomic Energy Agency, Vienna (Austria)). Jan 1987. 39p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87702734.

The purpose of this document is to develop criteria for siting and the site-related design basis for research reactors. The concepts presented in this document are intended as recommendations for new reactors and are not suggested for backfitting purposes for facilities already in existence. In siting research reactors serious consideration is given to minimizing the effects of the site on the reactor and the reactor on the site and the potential impact of the reactor on the environment. In this document guidance is first provided on the evaluation of the radiological impact of the installation under normal reactor operation and accident conditions. A classification of research reactors in groups is then proposed, together with a different approach for each group, to take into account the relevant safety problems associated with facilities of different characteristics. Guidance is also provided for both extreme natural events and for man-induced external events which could affect the safe operation of the reactor. Extreme natural events include earthquakes, flooding for river or coastal sites and extreme meteorological phenomena. The feasibility of emergency planning is finally considered for each group of reactors. 14 references, 3 tables.

40943 **(INIS-BR—674) Negative ecologic impact of hydroelectric power plants and nuclear power plants.** Goldemberg, J.; Padua, M.T.J. (Centrais Eletricas de Sao Paulo (Brazil)). [30 Apr 1987]. 9p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702781.

The degree of interference, the benefit obtained and, the alternative measurements to minimize the negative ecologic impacts from hydroelectric and nuclear power plants are discussed.

40944 **(KURRI-TR—276) Development of dynamic simulator for thermosyphon evaporator process with an application.** Shimizu, Y.; Tsutsui, T. (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.). Jun 1986. 36p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. File Number DE87702656.

A dynamic simulator has been developed for radwaste evaporator system in the Research Reactor Institute of Kyoto University. Under mild assumptions, two-phase flow model of the thermosyphon evaporator was shown to be modelled by a set of ordinary and algebraic equations. Through a structure analysis of such equations, a compact but efficient computer program was realized using FORTRAN computer language. By comparing numerical results with experimental ones, reliability of the model has been examined. Furthermore, mentioning several applications imbedded into the developed simulator, a bi-objective optimal problem was formulated generally, and then solved numerically through a practical procedure. It is expected that such a consideration is helpful for the radwaste management in practice.

40945 **(NUREG/CR—4871) Results from the DCH-1 [Direct Containment Heating] experiment.** Tarbell, W.W.; Brockmann, J.E.; Pilch, M.; Ross, J.E.; Oliver, M.S.; Lucero, D.A.; Kerley, T.E.; Arellano, F.E.; Gomez, R.D. (Sandia National Labs., Albuquerque, NM (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor Systems Safety). May 1987. Contract AC04-76DP00789. 67p. (SAND—86-2483). NTIS, PC A04/MF A01 - GPO. File Number TI87012097.

The DCH-1 (Direct Containment Heating) test was the first experiment performed in the Surtsey Direct Heating Test Facility. The test involved 20 kg of molten core debris simulant ejected into a 1:10 scale model of the Zion reactor cavity. The melt was produced by a metallothermic reaction of iron oxide and aluminum powders to yield molten iron and alumina. The cavity model was placed so that the emerging debris propagated directly upwards along the vertical centerline of the chamber. Results from the experiment showed that the molten material was ejected from the caviity as a cloud of particles and aerosol. The dispersed debris caused a rapid pressurization of the 103-m^3 chamber atmosphere. Peak pressure from the six transducers ranged from 0.09 to 0.13 MPa (13.4 to 19.4 psig) above the initial value in the chamber. Post-test debris collection yielded 11.6 kg of material outside the cavity, of which approximately 1.6 kg was attributed to the uptake of oxygen by the iron particles. Mechanical sieving of the recovered debris showed a lognormal size distribution with a mass mean size of 0.55 mm. Aerosol measurements indicated a subsantial portion (2 to 16%) of the ejected mass was in the size range less than 10 m aerodynamic equivalent diameter.

2206 Research, Test, And Experimental Reactors

REFER ALSO TO CITATION(S) 40928, 40944, 40970, 40971, 41017, 41064, 41069, 41070, 41306

40946 **(CONF-861185—4) Comparison of calculated and measured irradiated wire data for HEU and mixed HEU/LEU cores in the ORR [Oak Ridge Research Reactor].** Cornella, R.J.; Bretscher, M.M.; Hobbs, R.W. (Argonne National Lab., IL (USA); Oak Ridge National Lab., TN (USA)). 1986. Contract W-31109-ENG-38. 9p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87004924.

From Reduced Enrichment for Research and Test Reactors (RERTR) program international meeting; Gatlinburg, TN, USA (3 Nov 1986).

Low power wire activations are being performed in the Oak Ridge Research Reactor (ORR) as part of the whole-core LEU demonstration experiments. Calculations of the demonstration cores, including simulation of the wire activations, are being performed at Argonne National Laboratory (ANL). This paper presents the results of comparisons for 293 wires from five cores and shows that, on the average, the integrated activities agree within 6%.

40947 **(CONF-861185—10) A study of the effect of fabrication variables on the void content and quality of fuel plates.** Wiencek, T.C. (Argonne National Lab., IL (USA)). Oct 1986. Contract W-31109-ENG-38. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87004702.

From Reduced Enrichment for Research and Test Reactors (RERTR) program international meeting; Gatlinburg, TN, USA (3 Nov 1986).

The control of void content and quality of dispersion type fuel plates fabricated for research and test reactors are issues of concern to plate fabricators. These two variables were studied by examining the data for various geometries of fuel plates fabricated at ANL. It was found that the porosity of a fuel plate can be increased by: (1) decreasing the fuel particle size, (2) increasing the fuel particle surface roughness, (3) increasing the matrix strength, (4) decreasing the rolling temperature, (5) decreasing the final fuel zone thickness, and (6) increasing the volume percentage of the fuel. Porosity formation is controlled by bulk movement and deformation and/or fracture of particles. The most important factor is the flow stress of the matrix material. Lowering the flow stress will decrease the plate porosity. The percentage of plates with fuel-out-of-zone is a function of the fuel material and the loading. The highest percentage of plates with fuel-out-of-zone were those with U_3Si_2 which is at this time the most commonly used silicide fuel.

40948 **(CONF-870102—12) Fast critical experiment data for space reactors.** Collins, P.J.; McFarlane, H.F.; Olsen, D.N.; Atkinson, C.A.; Ross, J.R. (Argonne National Lab., Idaho Falls, ID (USA)). 1987. Contract W-31-109-ENG-38. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87007005.

From 4. symposium on space nuclear power systems; Albuquerque, NM, USA (12 Jan 1987).

Data from a number of previous critical experiments exist that are relevant to the design concepts being considered for SP-100 and MMW space reactors. Although substantial improvements in experiment techniques have since made some of the measured quantities somewhat suspect, the basic criticality data are still useful in most cases. However, the old experiments require recalculation with modern computational methods and nuclear cross section data before they can be applied to today's designs. Recently, we have calculated about 20 fast benchmark critical experiments with the latest ENDF/B data and modern transport codes. These calculations were undertaken as a part of the planning process for a new series of benchmark experiments aimed at supporting preliminary designs of SP-100 and MMW space reactors.

40949 **(CONF-870288—3-Vugraphs) Status of the ETR systems code development and design space studies.** Peng, M. (Oak Ridge National Lab., TN (USA)). 9 Feb 1987. Contract AC05-84OR21400. 11p. NTIS, PC A02. File Number DE87008784.

From TIBER/ETR design meeting; Livermore, CA, USA (9 Feb 1987).

This report outlines the status of the Engineering Test Reactor (ETR) system codes by module and expected completion date. Preliminary ETR design space studies have also been completed and several sensitive design assumptions and constraints have been identified. A preliminary study of TF coil technology has also been performed for the TIBER/ETR Engineering phase and design constraints are listed. (FI)

40950 **(CONF-870812—14) Vibrational experiments at the HDR [Heissdampfreaktor] German/US cooperation.** Kot, C.A.; Malcher, L.; Costello, J.F. (Argonne National Lab., IL (USA); Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.); Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research). Apr 1987. Contract W-31109-ENG-38. 37p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011398.

From 9. SMIRT: international conference on structural mechanics in reactor technology; Lausanne, Switzerland (17 Aug 1987).

As part of an overall effort on the validation of seismic calculational methods, the US NRC/RES is collaborating with the Kernforschungszentrum Karlsruhe, FRG, in the vibrational/earthquake experiments conducted at the HDR (Heissdampfreaktor) Test Facility in Kahl/Main, FRG. In the most recent experiments (SHAG), high level excitations were produced in the HDR by means of an eccentric-mass coastdown shaker capable of developing 1000 tons of force. The purpose of the experiments was to investigate full-scale structural response, soil-structure interaction, and piping and equipment response. Data obtained in the tests serve to evaluate analysis methods. In the SHAG experiments, loadings of the HDR soil-structure system approached incipient failure levels as evidenced by high peak accelerations and displacements, local damage, nonlinear behavior, soil subsidence, and wall strains which exceeded estimated limit values. Also, the performance of different pipe hanger configurations for the VKL piping system was compared in these tests under high excitation levels. The support configurations ranged from very rigid systems (strut/snubbers) to very flexible configurations (spring and constant force supports). Pretest and post-test analyses for the building/soil and piping response were performed and are being validated with the test data.

40951 **(DOE/NE/37959—5) Reactor noise diagnostics based on multivariate autoregressive modeling: Application to LOFT [Loss-of-Fluid-Test] reactor process noise.** Gloeckler, O.; Upadhyaya, B.R. (Tennessee Univ., Knoxville (USA). Dept. of Nuclear Engineering). 1987. Contract AC02-86NE37959. 38p. (CONF-870598—2). NTIS, PC A03. File Number DE87011871.

From 4. conference on utility experience in reactor noise analysis; Hartford, CT, USA (12 May 1987).

Multivariate noise analysis of power reactor operating signals is useful for plant diagnostics, for isolating process and sensor anomalies, and for automated plant monitoring. In order to develop a reliable procedure, the previously established techniques for empirical modeling of fluctuation signals in power reactors have been improved. Application of the complete algorithm to operational data from the Loss-of-Fluid-Test (LOFT) Reactor showed that earlier conjectures (based on physical modeling) regarding the perturbation sources in a Pressurized Water Reactor (PWR) affecting coolant temperature and neutron power fluctuations can be systematically explained. This advanced methodology has important implication regarding plant diagnostics, and system or sensor anomaly isolation. 6 refs., 24 figs.

40952 **(HEDL-SA—3462) Three year fast reactor fuel system.** Lovell, A.J.; Mahagin, D.E. (Hanford Engineering Development Lab., Richland, WA (USA)). Mar 1986. Contract AC06-76FF02170. 27p. (CONF-860418—26). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87010713.

From 88. annual meeting of the American Ceramic Society; Chicago, IL, USA (27 Apr 1986).

Typically, the target fuel residence time is considered to be three or five years at characteristic core power levels. Until recently, such exposure goals were well beyond the performance capability of recognized core materials. Improved cladding and duct materials now provide the opportunity to achieve the necessary burnup levels and, thus, to exploit the economic benefits. Using the most promising of these materials, a test program designed to establish the performance capabilities of prototypic LMR fuel and blanket assemblies in the Fast Flux Test Facility (FFTF) has been implemented. The program is intended to verify the superior performance of advanced components and provide a statistically significant demonstration in an environment that is representative of future LMR plants.

40953 **(HEDL-SA—3497) High burnup performance of an advanced oxide fuel assembly in FFTF [Fast Flux Test Facility] with ferritic/martensitic materials.** Bridges, A.E.; Saito, G.H.; Lovell, A.J.; Makenas, B.J. (Hanford Engineering Development Lab., Richland, WA (USA)). May 1986. Contract AC06-76FF02170. 12p. (CONF-860931—24). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010719.

From International conference on reliable fuels for liquid metal reactors; Tucson, AZ, USA (7 Sep 1986).

An advanced oxide fuel assembly with ferritic/martensitic materials has successfully completed its sixth cycle of irradiation in the FFTF, reaching a peak pellet burnup greater than 100 MWd/KgM and a peak fast fluence greater than 15 x 10^{22} n/cm^2. The cladding, wire-wrap, and duct material for the ACO-1 test assembly is the ferritic/martensitic alloy, HT9, which was chosen for use in long-lifetime fuel assemblies because of its good nominal temperature creep strength and low swelling rate. Valuable experience on the performance of HT9 materials has been gained from this test, advancing our quest for long-lifetime fuel. Pertinent data, obtained from the ACO-1 test assembly, will support the irradiation of the Core Demonstration Experiment in FFTF.

40954 **(JAERI-M—86-136) Analysis of the SPERT III E-core experiment using the EUREKA-2 code.** Harami, T.; Uemura, M.; Ohnishi, N. (Japan Atomic Energy Research Inst., Tokyo). Sep 1986. 88p. NTIS (US Sales Only), PC A05/MF A01. File Number DE87702619.

EUREKA-2, a coupled nuclear thermal hydrodynamic kinetic code, was adapted for the testing of models and methods. Code evaluations were made with the reactivity addition experiments of the SPERT III E-Core, a slightly enriched oxide core. The code was tested for non damaging power excursions including a wide range of initial operating conditions, such as cold-startup, hot-startup, hot-standby and operating-power initial conditions. Comparisons resulted in a good agreement within the experimental errors between calculated and experimental power, energy, reactivity and clad surface temperature.

40955 **(JAERI-M—86-138) Annual report on operation, utilization and technical development of research reactors and hot laboratory, from April 1, 1985 to March 31, 1986.** (Japan Atomic Energy Research Inst., Tokyo). Oct 1986. 219p. (In Japanese). NTIS (US Sales Only), PC A10/MF A01. File Number DE87702621.

Activities of the Department of Research Reactor Operation in fiscal year 1985 are described. The department is responsible for operation and maintenance of JRR-2, JRR-4, Research Reactor Development Division which performed upgraded JRR-3 and other R and D, and Hot Laboratory. In the above connection various other work has also been performed, such as technical management of fuel and coolant, radiation control, and irradiation technique. In Hot Laboratory, the authors have performed post-irradiation examinations of fuels and materials, and also development of examination procedures, too.

40956 **(JAERI-M—86-153) Numerical evaluation of shielding analysing procedures for the upgraded JRR-3 research reactors. Number of energy groups, number of spatial meshes, number of angular quadratures, bootstraps' width, attenuation curve of shielding materials, radiation source.** Ise, T.; Maruo, T.; Umeda, K. (Japan Atomic Energy Research Inst., Tokyo). Nov 1986. 103p. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. File Number DE87702633.

Description is about the numerical evaluation of the analytical parameters in the shielding analysing procedures for the upgraded JRR-3 research reactor: number of energy groups, number of spatial meshes, number of angular quadratures and the bootstraps' width used in S/sub N/ calculations; dose rate attenuation curves; and radiation source.

40957 **(JAERI-M—86-155) Evaluation of power distributions caused by photoneutrons born in the reflectors of the upgraded JRR-3 research reactor.** Ise, T.; Maruo, T.; Miyasaka, Y.; Narita, H. (Japan Atomic Energy Research Inst., Tokyo). Nov 1986. 39p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. File Number DE87702635.

Description is about an evaluation of power distributions caused by the photoneutrons born in the reflectors, beryllium and heavy water, of the upgraded JRR-3 research reactor, which photoneutrons become a neutron source at restarting of the reactor. The intensity of gamma-rays after reactor shutdown is calculated by the ORIGEN, the gamma-ray distribution by the DOT, and the power distribution due to photoneutrons by the CITATION.

40958 **(ORNL—6240) Health physics research reactor reference dosimetry.** Sims, C.S.; Ragan, G.E. (Oak Ridge National Lab., TN (USA)). Jun 1987. Contract AC05-84OR21400. 85p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87013358.

Reference neutron dosimetry is developed for the Health Physics Research Reactor (HPRR) in the new operational configuration directly above its storage pit. This operational change was physically made early in CY 1985. The new reference dosimetry considered in this document is referred to as the 1986 HPRR reference dosimetry and it replaces any and all HPRR reference documents or papers issued prior to 1986. Reference dosimetry is developed for the unshielded HPRR as well as for the reactor with each of five different shield types and configurations. The reference dosimetry is presented in terms of three different dose and six different dose equivalent reporting conventions. These reporting conventions cover most of those in current use by dosimetrists worldwide. In addition to the reference neutron dosimetry, this document contains other useful dosimetry-related data for the HPRR in its new configuration. These data include dose-distance measurements and calculations, gamma dose measurements, neutron-to-gamma ratios, "9-to-3 inch" ratios, threshold detector unit measurements, 56-group neutron energy spectra, sulfur fluence measurements, and details concerning HPRR shields. 26 refs., 11 figs., 31 tabs.

40959 **(ORNL/TM—10432) Oak Ridge Research Reactor quarterly report, January, February, and March 1987.** Hamrick, T.P.; Ford, M.K. (Oak Ridge National Lab., TN (USA)). Jun 1987. Contract AC05-84OR21400. 49p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011946.

The ORR operated at an average power level of 29.6 MW for 72.0% of the time during January, February, and March of 1987. The reactor was shut down on seventeen occasions, six of which were unscheduled. Reactor downtime needed for refueling and checks was normal. The reactor remained available for operation 88.1% of the time. Maintenance activities, both mechanical and instrument, were essentially routine in nature with the exception of maintenance on a shim-safety rod drive. Special tests completed during the quarter included: (1) continuation of the RERTR whole-core demonstration; and (2) core physics measurements completed during the quarter to gather purposeful data to accommodate the RERTR whole-core demonstration.

40960 **(PNL-SA—14228) Two-phase reduced gravity experiments for a space reactor design.** Antoniak, Z.I. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1986. Contract AC06-76RL01830. 9p. (CONF-8609146—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE86015530.

From Microgravity fluid management symposium; Cleveland, OH, USA (9 Sep 1986).

Future space missions envision the use of large nuclear reactors utilizing either a single or a two-phase alkali-metal working fluid. The design and analysis of such reactors require state-of-the-art computer codes that can properly treat alkali-metal flow and heat transfer in a reduced-gravity environment. New flow regime maps, models, and correlations are required if the codes are to be successfully applied to reduced-gravity flow and heat transfer. General plans are put forth for the reduced-gravity experiments which will have to be performed, at NASA facilities, with benign fluids. Data from the reduced-gravity experiments with innocuous fluids are to be combined with normal gravity data from two-phase alkali-

metal experiments. Because these reduced-gravity experiments will be very basic, and will employ small test loops of simple geometry, a large measure of commonality exists between them and experiments planned by other organizations. It is recommended that a committee be formed, to coordinate all ongoing and planned reduced gravity flow experiments.

40961 **(ZfK—597) Investigation of heterogeneity effects of the critical assembly BFS-45.** Dulin, V.A.; Shapar', A.V.; Kunzmann, B. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). 1986. 20p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702875.

These investigations aim to determine the influence of the heterogeneity due to BFS test facility design on physical characteristics of the BFS-45 configuration. In order to estimate the calculation models the calculated values of spectral indices of fission isotopes are compared in the heterogeneous configurations with experimentally determined values of these indices. It is demonstrated that most of the calculated values basing on the BNAB-78 cross section library agree with the measured values within the measurement error range.

2207 Plutonium And Isotope Production Reactors

REFER ALSO TO CITATION(S) 41075, 41080, 41337

40962 **(UNI—3146-Rev.1) Assessment of N-Reactor Zircaloy-2 pressure tube corrosion and hydriding trends.** Johnson, A.B.; Lanning, D.D. (UNC Nuclear Industries, Inc., Richland, WA (USA)). Aug 1985. Contract AC06-76RL01857. 54p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87007103.

Corrosion and hydriding of N-Reactor Zircaloy-2 pressure tubes have been monitored by periodic removal of tubes for destructive examination. To date, nine tubes have been examined, representing exposures from 1400 to 14,500 MWd (439 to 3860 operating days). Oxide profiles on tube inside (water side) surfaces generally follow the flux profile, indicating radiation enhancement of corrosion. Maximum oxide thickness increases with increasing exposure, reaching ~50 μm (0.002 in.) in the most recently examined tubes. Oxides on tube outside (gas side) surfaces are much thinner (up to 15 μm) and do not consistently relate to the flux profile. Two zones of accelerated hydriding have been identified along the tube lengths: (1) in upstream, out-of-flux tube sections; and (2) in the flux zone, directly related to the corresponding oxide profiles. In high exposure tubes, peak in-flux hydrogen concentrations exceed peak values at out-of-flux locations. Models have been developed to project future oxide and hydriding trends. Peak oxidation of the inside surface is expected to continue at a rate of 0.016 μm per effective full power day (EFPD) or 4.0 μm per 1000 MWd. The peak axial hydrogen concentration (wall average) is expected to increase at the rate of 21 ppM per 1000 MWd. The high hydrogen concentrations near the tube inside surface are expected to reach levels of 1000 to 2000 ppM (over 20% of the wall) in less than 6000 MWd (less than 5 y).

40963 **(UNI—3620) Investigations in support of assessment of corrosion and hydriding trends in N Reactor Zircaloy-2 pressure tubes.** Clark, R.L.; Charlot, L.A.; Lanning, D.D.; Johnson, A.B.; Guenther, R.J. (UNC Nuclear Industries, Inc., Richland, WA (USA)). Jun 1986. Contract AC06-76RL01857. 68p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87007102.

Two studies were made to support the assessment of corrosion and hydriding trends in N-Reactor Zircaloy-2 pressure tubes. The first study consisted of chemical, microchemical (chemistry of microstructural features) and microstructural analyses of six lots of Zircaloy-2 which had demonstrated differences in corrosion and hydriding behavior during previous in-reactor and ex-reactor corrosion testing. The second study included chemical, microchemical and microstructural examinations on archive specimens of pressure tubes 2755, 2566, and 1054 to investigate the low hydriding of tube 2755. Metallography, x-ray diffraction, and a review of factors affecting hydrogen uptake were also conducted to support the assessment of the low hydriding of tube 2755. Results of these examinations are given in this report.

40964 **(UNI-SA—203) Backflushable filter experience at the N Reactor.** Ball, B.R.; Best, W.T.; Keith, R.C. (UNC Nuclear Industries, Inc., Richland, WA (USA); Impell Corp., Walnut Creek, CA (USA)). 23 Feb 1987. Contract AC06-76RL01857. 12p. (CONF-870306—39). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006591.

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

N Reactor is a 4000 MWt, light-water cooled, graphite-moderated reactor located on the Hanford Site in Washington state. A radwaste pilot plant to process plant effluent was constructed in order to maximize future efficiency when a full size radioactive processing facility is built. The pilot plant's purpose is to vary operational parameters such as filtration and ion exchange on a smaller scale to gather as much data as possible. The input to the pilot plant is radioactive drain lines from the N Reactor. The effluent passes through a backflushable filter and a series of ion exchange columns all scaled down from the future proposed facility. A backflushable filter was selected for this application because of the specific characteristics of the plant effluent and the potential reduced operation costs. The filter performance has been excellent in terms of filtration of the effluent. Typical total suspended solids in the plant effluent range from 1 to 6.1 ppM; the filter reduces this value to less than 0.1 ppM. In addition to outstanding filtration efficiency, the use of a precoat material on the filter has resulted in impressive decontamination factors. The filter has been successful in removing up to 50% of the influent activity. An improved performance of several nuclides over other filtration systems has also been achieved. By varying the composition and amount of precoat material on the filter, substantial reductions in waste volumes (and associated operating and disposal costs) have been demonstrated while maintaining a high degree of removal of both activity and total suspended solids.

2209 Reactor Safety

REFER ALSO TO CITATION(S) 40651, 40886, 40887, 40888, 40892, 40914, 40942, 40950, 41647, 41928

40965 **(BNL-NUREG—39975) Improved reliability of residual heat removal capability in pressurized water reactors.** Chu, Tsong-Lun; Fitzpatrick, R.; Yoon, Won Hyo. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 5p. (CONF-870820—5). NTIS, PC A02/MF A01; GPO Dep. File Number DE87012873.

From PSA 87: international topical meeting on probabilistic safety assessment and risk management; Zurich, Switzerland (31 Aug 1987).

The work presented in this paper was performed by Brookhaven National Laboratory (BNL) in supporting Nuclear Regulatory Commission's (NRC) effort towards the resolution of Generic Issue 99 "Reactor Coolant System (RCS)/Residual Heat Removal (RHR) Suction Line Interlocks on Pressurized Water Reactors (PWRs)." Operational experience of US PWRs indicates that numerous loss of RHR events have occurred during plant shutdown. Of particular significance is the loss of RHR suction due to the inadvertent closure of the RHR suction/isolation valves or an excess lowering of the water level in the reactor vessel. In the absence of prompt mitigative action by the operator, the core may become uncovered. Various design/operational changes have been proposed. The objective of this paper is to estimate the improvement in the RHR reliability and the risk reduction potential provided by those proposed RHR design/operational changes. The benefits of those changes are expressed in terms of the reduction in the frequency of loss-of-cooling events and the frequency of core damage.

40966 **(CEA-CONF—8813) Results of laboratory tests on the rustic filtration of the containment atmosphere of a PWR in case of severe accident. (Program PITEAS).** L'Homme, A.; Berlin, M.; Beraud, G. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). Sep 1986. 14p. (In French). (CEA-DAS—286; CONF-8512109—). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752283.

From SFEN meeting on accidental releases and source terms in case of serious accident in pressurized water reactors; Paris, France (18 Dec 1985).

This paper presents the reasons of the PITEAS program as also the basic data. Then, the results of laboratory tests are given, and finally the characteristics of the filtration material (sand) chosen for the rustic filtration system, to be implanted on reactors and for the 2nd part of the test program, are given.

40967 **(CEA-CONF—8816) Application of the core-concrete interaction code Wechsl to reactor case.** Cenerino, G. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). Sep 1986. 12p. (CEA-DAS—285; CONF-8609126—7). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752282.

From Committee on the Safety of Nuclear Installations (CSNI) specialists' meeting on core debris/concrete interactions; Palo Alto, CA, USA (3 Sep 1986).

The WECHSL code, developed at Kernforschungszentrum Karlsruhe, West-Germany, is used for core melt accidents in nuclear power plants. The first calculations, considering silicate and limestone/common sand concretes of different compositions, analyze the influence of the initial mass of Zirconium in the corium and, in one case, the effect of sump water ingression on the top of the melt. Moreover, for a limestone concrete, a sensitivity study is made on the melting temperature of the concrete influencing the decomposition enthalpy. The main conclusion of that paper is that, in any case, the temperature of the melt drops rapidly from the initial temperature to a temperature level close to the solidification temperature of the metal phase in a relatively short period of time (approximately 15 minutes) and then a balance between the removed heat from the melt and heating sources inside the melt is established.

40968 **(CEA-IPSN-INFO—47) Repair of EL4 leaks.** (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Inst. de Protection et de Surete Nucleaire). Mar 1985. 4p. (In French). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752277.

The reactor shutdown was decided on the 15th of November 1984, because the evolution of the carbon dioxide quantity in the helium blanket of the heavy water. Leaks have been localized on three different channels. Repairs have been made in hard conditions taking into account the reactor state (materials strongly irradiated). The restart has been authorized on the 24th of January 1985.

40969 **(CEA-IPSN-INFO—49-Rev.1) EDF's PWR power plants: anomalies concerning the reactor core instrumentation system.** (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Inst. de Protection et de Surete Nucleaire). Oct 1985. 3p. (In French). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752278.

This report presents the problems of fatigue and leaks found on the internal core instrumentation thimbles of several French PWR power plants, as also the solutions chosen according the reactor has already or not been operating.

40970 **(CONF-870415—3) Demonstration of passive safety features in EBR-II.** Planchon, H.P. Jr.; Golden, G.H.; Sackett, J.I. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 23p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011411.

From American power conference; Chicago, IL, USA (27 Apr 1987).

Two tests of great importance to the design of future commercial nuclear power plants were carried out in the Experimental Breeder Reactor-II on April 3, 1986. These tests, (viewed by about 60 visitors, including 13 foreign LMR specialists) were a loss of flow without scram and a loss of heat sink without scram, both from 100% initial power. In these tests, inherent feedback shut the reactor down without damage to the fuel or other reactor components. This resulted primarily from advantageous characteristics of the metal driver fuel used in EBR-II. Work is currently underway at EBR-II to develop a control strategy that promotes inherent safety characteristics, including survivability of transient overpower accidents. In parallel, work is underway at EBR-II on the development of state-of-the-art plant diagnostic techniques.

40971 **(CONF-870418—6) The integral fast reactor.** Till, C.E. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 8p. NTIS, PC A02. File Number DE87011410.

From Topical meeting on anticipated and abnormal transients in nuclear power plants; Atlanta, GA, USA (12 Apr 1987).

On April 3rd, 1986, two dramatic demonstrations of the inherent capability of sodium-cooled fast reactors to survive unprotected loss of cooling accidents were carried out on the experimental sodium-cooled power reactor, EBR-II, on the Idaho site of Argonne National Laboratory. Transients potentially of the most serious kind, one an unprotected loss of flow, the other an unprotected loss of heat sink, both initiated from full power. In both cases the reactor quietly shut itself down, without damage of any kind. These tests were a part of the on-going development program at Argonne to develop an advanced reactor with significant new inherent safety characteristics. Called the Integral Fast Reactor, or IFR, the basic thrust is to develop everything that is needed for a complete nuclear power system - reactor, closed fuel cycle, and waste processing - as a single optimized entity, and, for simplicity in concept, as an integral part of a single plant. The particular selection of reactor materials emphasizes inherent safety characteristics and also makes possible a simplified closed fuel cycle and waste process improvements.

40972 **(CONF-870424—14) The integral fast reactor (IFR) concept: Physics of operation and safety.** Wade, D.C.; Chang, Y.I. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011533.

From American Nuclear Society international meeting on advances in reactor physics, mathematics and computation; Paris, France (27 Apr 1987).

The IFR concept employs a pool layout, a U/Pu/Zr metal alloy fuel and a closed fuel cycle based on pyrometallurgical reprocessing and injection casting refabrication. The reactor physics issues of designing for inherent safety and for a closed fissile self-sufficient integral fuel cycle with uranium startup and potential actinide transmutation are discussed.

40973 **(CONF-870472—3) SAS4A: A computer model for the analysis of hypothetical core disruptive accidents in liquid metal reactors.** Tentner, A.M.; Birgersson, G.; Cahalan, J.E.; Dunn, F.E.; Kalimullah; Miles, K.J. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 37p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011524.

From Eastern simulation conference; Orlando, FL, USA (6 Apr 1987).

To ensure that the public health and safety are protected under any accident conditions in a Liquid Metal Fast Breeder Reactor (LMFBR), many accidents are analyzed for their potential consequences. The SAS4A code system, described in this paper, provides such an analysis capability, including the ability to analyze low probability events such as the Hypothetical Core Disruptive Accidents (HCDAs). The SAS4A code system has been designed to simulate all the events that occur in a LMFBR core during the initiating phase of a Hypothetical Core Disruptive Accident. During such postulated accident scenarios as the Loss-of-Flow and Transient Overpower events, a large number of interrelated physical phenomena occur during a relatively short time. These phenomena include transient heat transfer and hydrodynamic events, coolant boiling and fuel and cladding melting and relocation. During to the strong neutronic feedback present in a nuclear reactor, these events can significantly influence the reactor power. The SAS4A code system is used in the safety analysis of nuclear reactors, in

order to estimate the energetic potential of very low probability accidents. The results of SAS4A simulations are also used by reactor designers in order to build safer reactors and eliminate the possibility of any accident which could endanger the public safety.

40974 **(CONF-870601—18) Validation of a model for faster than real time LMFBR core transient analysis.** Tzanos, C.P. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011439.

From Annual meeting of the American Nuclear Society; Dallas, TX, USA (7 Jun 1987).

This report briefly describes experimental validation of a computer model used to analyze LMFBR type core transients. This model is used to predict coolant, cladding, and fuel temperature distributions during transient overpower accidents. (JDH)

40975 **(CONF-870636—13) Sloshing and fluid-structure interaction in a 400-MWe pool-type advanced fast reactor.** Ma, D.C.; Gvildys, J.; Chang, Y.W. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 13p. NTIS, PC A02. File Number DE87011441.

From 5. national congress on pressure vessels and piping; San Diego, CA, USA (28 Jun 1987).

This paper describes the seismic analysis of a 400-MWe advanced fast reactor under 0.3 g SSE ground excitation. Two types of analyses are performed - the sloshing analysis and the fluid-structure interaction analysis. In the sloshing analysis, the sloshing frequency and wave patterns are calculated. The maximum wave height and the sloshing forces exerted on the submerged components and the primary tank are evaluated. In the fluid-structure interaction analysis, the maximum horizontal acceleration for the reactor core and the relative displacement between the reactor core and UIS are examined. The fluid-coupling phenomena between various components are investigated. Seismic stresses at critical areas are examined. The results obtained from this study are very useful to the design of the advanced reactors. Meanwhile, the computer code FLUSTR-ANL has proved to be a useful analytical tool for assessing the complicated seismic fluid-structure interactions and sloshing in the fast reactor systems. 10 refs., 25 figs.

40976 **(CONF-870812—13) Seismic analysis of liquid metal reactor piping systems.** Wang, C.Y. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011400.

From 9. SMIRT: international conference on structural mechanics in reactor technology; Lausanne, Switzerland (17 Aug 1987).

To safely assess the adequacy of the LMR piping, a three-dimensional piping code, SHAPS, has been developed at Argonne National Laboratory. This code was initially intended for calculating hydrodynamic-wave propagation in a complex piping network. It has salient features for treating fluid transients of fluid-structure interactions for piping with in-line components. The code also provides excellent structural capabilities of computing stresses arising from internal pressurization and 3-D flexural motion of the piping system. As part of the development effort, the SHAPS code has been further augmented recently by introducing the capabilities of calculating piping response subjected to seismic excitations. This paper describes the finite-element numerical algorithm and its applications to LMR piping under seismic excitations. A time-history analysis technique using the implicit temporal integration scheme is addressed. A 3-D pipe element is formulated which has eight degrees of freedom per node (three displacements, three rotations, one membrane displacement, and one bending rotation) to account for the hoop, flexural, rotational, and torsional modes of the piping system. Both geometric and material nonlinearities are considered. This algorithm is unconditionally stable and is particularly suited for the seismic analysis.

40977 **(CONF-870812—15) Dominant seismic sloshing mode in a pool-type reactor tank.** Ma, D.C.; Gvildys, J.; Chang, Y.W. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011401.

From 9. SMIRT: international conference on structural mechanics in reactor technology; Lausanne, Switzerland (17 Aug 1987).

Large-diameter LMR (Liquid Metal Reactor) tanks contain a large volume of sodium coolant and many in-tank components. A reactor tank of 70 ft. in diameter contains 5,000,000 of sodium coolant. Under seismic events, the sloshing wave may easily reach several feet. If sufficient free board is not provided to accommodate the wave height, several safety problems may occur such as damage to tank cover due to sloshing impact and thermal shocks due to hot sodium, etc. Therefore, the sloshing response should be properly considered in the reactor design. This paper presents the results of the sloshing analysis of a pool-type reactor tank with a diameter of 39 ft. The results of the fluid-structure interaction analysis are presented in a companion paper. Five sections are contained in this paper. The reactor system and mathematical model are described. The dominant sloshing mode and the calculated maximum wave heights are presented. The sloshing pressures and sloshing forces acting on the submerged components are described. The conclusions are given.

40978 **(CONF-870812—18) Seismic analysis of a 400-MWe pool-type fast reactor.** Ma, D.C.; Gvildys, J. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011470.

From 9. SMIRT: international conference on structural mechanics in reactor technology; Lausanne, Switzerland (17 Aug 1987).

This paper presents a seismic analysis of a 400-MWe pool-type fast reactor subjected to horizontal support excitation. Two types of analyses are performed - the fluid-structure interaction analysis and the sloshing analysis. In the fluid-structure interaction analysis, the fluid coupling between various components are investigated. The maximum horizontal acceleration for the reactor core and the relative displacement between the reactor core and UIS (Upper Internal Structure) are examined. Seismic stresses at critical areas are calculated. In the sloshing analysis, the sloshing frequency and wave patterns are calculated. The maximum wave height and the sloshing forces exerted on the submerged components and the primary tank are evaluated.

40979 **(CONF-870812—19) Vibration testing and analysis of a multiply supported piping system.** Hsieh, B.J.; Kot, C.A.; Srinivasan, M.G. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011474.

From 9. SMIRT: international conference on structural mechanics in reactor technology; Lausanne, Switzerland (17 Aug 1987).

The behavior of nuclear power plant piping systems during earthquake, and the most appropriate and economical mode of supporting such piping, is an issue of major concern. Consequently, the verification and validation of piping analysis methods and assumptions used in the design and safety assessment of nuclear power plants are of great interest. As part of its program on the validation of seismic calculational methods the US Nuclear Regulatory Commission (NRC) is specifically interested in the validation of the multiple support piping analysis module of the SMACS (Seismic Methodology Analysis Chain with Statistics) computer code. Data for the comparison of the dynamic behavior of various pipe hanger configurations and for the validation of piping response analyses were recently obtained in the large shaker experiments (SHAG) conducted at the HDR (Heissdampfreaktor) test facility in Kahl/Main, Federal Republic of Germany. This paper describes preliminary results from the SHAG piping response tests and the approach taken in the validation of the SMACS code piping analysis.

40980 **(CONF-870812—26) An assessment of LMR reactor core vertical acceleration under seismic events.** Ma, D.C.; Seidensticker, R.W. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011468.

From 9. SMIRT: international conference on structural mechanics in reactor technology; Lausanne, Switzerland (17 Aug 1987).

This paper presents an assessment of reactor core vertical accelerations for large-diameter LMR reactors under various core-support conditions. A review of the various types of core-support concepts in use for LMR plants is given. The vertical seismic response is determined for a pool-type reactor with a core supported by the reactor vessel bottom head. The vertical core seismic response of a LMR with a core supported by the side wall of the reactor vessel is given. Conclusions and design recommendations are also given.

40981 **(CONF-870812—27) TEMP-STRESS analysis of a reinforced concrete vessel under internal pressure.** Marchertas, A.H.; Kennedy, J.M.; Pfeiffer, P.A. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011466.

From 9. SMIRT: international conference on structural mechanics in reactor technology; Lausanne, Switzerland (17 Aug 1987).

Prediction of the response of the Sandia National laboratory 1/6-scale reinforced concrete containment model test was obtained by Argonne National Laboratory (ANL) employing a computer program developed by ANL. The test model was internally pressurized to failure. The two-dimensional code TEMP-STRESS [1-5] has been developed at ANL for stress analysis of plane and axisymmetric 2-D reinforced structures under various thermal conditions. The program is applicable to a wide variety of nonlinear problems, and is utilized in the present study. The comparison of these pretest computations with test data on the containment model should be a good indication of the state of the code.

40982 **(CONF-870816—21) The PARSEC computer code for analysis of direct containment heating by dispersed debris.** Sienicki, J.J.; Spencer, B.W. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 10p. NTIS, PC A02. File Number DE87011406.

From 24. national heat transfer conference and exhibition; Pittsburgh, PA, USA (9 Aug 1987).

A multiphase flow and heat transfer, coupled Lagrangian and Eulerian computer program, PARSEC, has been developed to predict the heatup of a gas atmosphere resulting from the gas-driven dispersal of high temperature debris droplets/particles as well as the associated formation of aerosol by the oxidation enhanced vaporization of metal from the surfaces of the droplets, oxidation of reactive debris constituents, and generation of hydrogen. Predictions of the code and the fundamental modeling incorporated therein are in good agreement with available data on the essentially unimpeded dispersal of high temperature melts involving reactor materials in the Argonne CWTI-13 and CWTI-14 experiments as well as iron-alumina thermite in the Sandia DCH-1 test.

40983 **(CONF-870816—27) Investigation of molten corium-concrete interaction phenomena and aerosol release.** Spencer, B.W.; Thompson, D.H.; Armstrong, D.R.; Fink, J.K.; Gunther, W.H.; Kilsdonk, D.J.; Sehgal, B.R. (Argonne National Lab., IL (USA); Electric Power Research Inst., Palo Alto, CA (USA)). 1987. Contract W-31109-ENG-38. 29p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011407.

From 24. national heat transfer conference and exhibition; Pittsburgh, PA, USA (9 Aug 1987).

The Electric Power Research Institute is sponsoring a program of laboratory investigations at Argonne National Laboratory to study the interaction between molten core materials and reactor concrete basemats during postulated severe reactor accidents, with particular emphasis on measurements of the magnitude and chemical species present in the aerosol releases. The approach in this program is to sustain internal heat generation in reactor-material corium using direct electrical heating and to develop test operating and diagnostics capabilities with a series of small- and intermediate-scale scoping tests followed by fully instrumented large-scale testing. Real reactor materials (UO_2, ZrO_2, oxides of stainless steel, plus metallics) are used, with small amounts of La_2O_3, BaO, and SrO added to simulate nonvolatile fission products. In intermediate-scale scoping tests completed to date, corium inventories of up to 29 kg have been heated with power inputs in excess of 1 kW/kg melt. The measured concrete ablation rates have ranged from 0.9 to 3.9 mm/minute. Aerosol samples have been examined using a scanning electron microscope and show submicron particles, 2-6 micrometer spheres, and agglomerates that range from a few micrometers to string 13 micrometers in length.

40984 **(CONF-870820—1) Probabilities of inherent shutdown of unprotected events in innovative liquid metal reactors.** Mueller, C.J. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87004949.

From PSA 87: international topical meeting on probabilistic safety assessment and risk management; Zurich, Switzerland (31 Aug 1987).

The uncertainty in predicting the effectiveness of inherent shutdown (ISD) in innovative designs results from three broad contributing areas of uncertainty: (1) the inability to exactly predict the frequency of ATWS events with potential to challenge the safety systems and require ISD; (2) the approximation of representing all such ATWS events by a selected set of "generic scenarios"; and (3) the inability to exactly calculate the core response to the selected generic scenarios. In this summary, the methodology and associated results of work used to establish probabilities of failure of inherent shutdown of innovative LMRs to the unprotected loss-of-flow (LOF) accident are discussed.

40985 **(CONF-8609126—6) Fission product release from core-concrete melts.** Tetenbaum, M.; Fink, J.K.; Johnson, C.E.; Ritzman, R.L. (Argonne National Lab., IL (USA); Electric Power Research Inst., Palo Alto, CA (USA)). 1986. Contract W-31109-ENG-38. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87004719.

From Committee on the Safety of Nuclear Installations (CSNI) specialists' meeting on core debris/concrete interactions; Palo Alto, CA, USA (3 Sep 1986).

Based on measurements with a He-H_2O carrier gas, release fraction values for lanthanum, barium, and strontium gaseous fission product species have been obtained from small-scale core-concrete melts at 2150 and 2385°K. The sample configuration consisted of a layer of limestone or basaltic concrete granules, a layer of urania fuel granules containing La_2O_3, BaO, and SrO in solid solution, and a metal layer consisting of a mixture of stainless steel and Zircaloy between the fuel and concrete. The following trends in fission product release fraction values were found: Ba > Sr > La. Release fraction values based on measured release of fuel, cladding, structural, and concrete species are presented.

40986 **(CONF-8705150—1) A void distribution model-flashing flow.** Riznic, J.; Ishii, M.; Afgan, N. (Argonne National Lab., IL (USA); Institut za Nuklearne Nauke Boris Kidric, Belgrade (Yugoslavia)). 1987. Contract W-31109-ENG-38. 17p. NTIS, PC A02. File Number DE87011430.

From International seminar on transient phenomena in multiphase flow; Belgrade, Yugoslavia (25 May 1987).

A new model for flashing flow based on wall nucleations is proposed here and the model predictions are compared with some experimental data. In order to calculate the bubble number density, the bubble number transport equation with a distributed source from the wall nucleation sites was used. Thus it was possible to avoid the usual assumption of a constant bubble number density. Comparisons of the model with the data shows that the model based on the nucleation site density correlation appears to be acceptable to describe the vapor generation in the flashing flow. For the limited data examined, the comparisons show rather satisfactory agreement without using a floating parameter to adjust the model. This result indicated that, at least for the experimental conditions considered here, the mechanistic predictions of the flashing phenomenon is possible on the present wall nucleation based model.

40987 **(DOE/NE—0083) SP-100 space reactor safety.** (USDOE Assistant Secretary for Nuclear Energy, Washington, DC). May 1987. 13p. H. File Number TI87011824.

The SP-100 space reactor power system is being developed to meet the large electrical power requirements of civilian and military missions planned for the 1990's and beyond. It will remove the restrictions on electrical power generation that have tended to limit missions and will enable the fuller exploration and utilization of

space. This booklet describes the SP-100 space reactor power system and its development. Particular emphasis is given to safety. The design aand operational features as well as the design and safety review process that will assure that the SP-100 can be launched nd operated safely are described.

40988 **(DOE/SSDP—0015) Shippingport Station Decommissioning Project Technology Transfer Program Plan.** (UNC Nuclear Industries, Shippingport, PA (USA). Shippingport Station Station Decommissioning Project Office). Oct 1986. Contract AC06-76RL01857;AC06-84RL10421. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87004496.

The Shippingport Station Decommissioning Project (SSDP) Technology Transfer Program (Program) has been established to record and disseminate technical information compiled from the decommissioning of the Shippingport Atomic Power Station. Program documentation will be available to the nuclear industry for use in planning future decommissioning of nuclear reactors. This Plan outlines the program for the technology transfer activities on the project with the intent to assure that: all project participants are fully cognizant of their responsibilities for technology transfer; the requirement for technology development and transfer by the US Department of Energy (DOE)/Surplus Facilities Management Program (SFMP) is met; and the SSDP serves as a demonstration project.

40989 **(EGG-M—35386) Stability of zircaloy oxidation during severe LWR [light water reactor] accidents.** Kuan, Pui. (EG and G Idaho, Inc., Idaho Falls (USA)). 1987. Contract AC07-76ID01570. 14p. (CONF-870816—15). NTIS, PC A02. File Number DE87009401.

From 24. national heat transfer conference and exhibition; Pittsburgh, PA, USA (9 Aug 1987).

The stability of zircaloy oxidation by steam at high temperatures under certain light water reactor (LWR) accident conditions is examined. When the oxidized surface radiates through a thin layer of steam to a cool heat sink, such as cooling water, it is found that the oxidation is stable, in the sense that no temperature escalation occurs due to the exothermic reaction, if (1) the temperature is below 1850 K (3330 R) and the zircaloy has been oxidized to a depth of about 15 μm (5.9×10^{-4} in.), and (2) the zircaloy has been oxidized to a depth of 67 μm (2.6×10^{-3} in.), regardless of temperature.

40990 **(EPRI—7900892) Advanced light water reactor requirements document: Chapter 4, Reactor systems.** (Combustion Engineering, Inc., Windsor, CT (USA); Duke Power Co., Charlotte, NC (USA); General Electric Co., Fairfield, CT (USA); Bechtel Power Corp., Gaithersburg, MD (USA); Levy (S.), Inc., Campbell, CA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jun 1987. 119p. NTIS, PC A06/MF A01. File Number DE87900892.

The purpose of this chapter of the Advanced Light Water Reactor (ALWR) Plant Requirements Document is to establish utility requirements for the design of the Reactor Systems of Advanced LWR plants consistent with the objectives and principles of the ALWR program. The scope of this chapter covers the following for Pressurized Water Reactor (PWR) and Boiling Water Reactor (BWR): reactor pressure vessel, nozzles and safe-ends, reactor internals, in-vessel portions of fluid systems (including reactor internal pumps (Emergency Core Cooling System (ECCS) piping and spargers), nuclear fuel, and the control rods and control rod drive system (including hydraulic supply and accumulators). Special tools required for reactor system maintenance, inspection and testing are also covered.

40991 (EPRI-CS/NP—3016-Vol.4B, pp 4.3-4.24) **MMS simulation of the first 1000 seconds of the TMI-2 accident.** Dion, D.R. (JAYCOR, San Diego, CA). Apr 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920392. (CONF-8409396—Vol.4B).

From Workshop on Modular Modeling System (MMS); New Orleans, LA, USA (26 Sep 1984).

The work described is part of a prerelease effort to test and validate the EPRI developed Modular Modeling System (MMS). A transient was run to menchmark the MMS code by comparing the transient results with both plant data and with results from RETRAN which is a more sophisticated and costly to run finite difference code. The transient chosen was the first 1000 seconds of the March 258, 1979 accident at the Unit 2 nuclear power plant on Three Mile Island (TMI-2). This transient was chosen for several reasons, among these are: plant data are available for comparison as is a RETRAN simulation. Furthermore, many interesting transient phenomena occur during the first 1000 seconds of the accident: a reactor scram; a loss of feedwater and subsequent dry out of the steam generators followed by refill when auxiliary feedwater is turned on; initiation and continuation of a small break in the hot leg; initiation and throttling of the high pressure injection pumps; two-phase flow conditions appear in the cold legs and the pressurizer becomes solid (i.e., it becomes totally filled with liquid). This wide variety of events enabled many of the aspects and capabilities of the MMS two-phase modules to be tested. The TMI-2 plant, the MMS model constructed to simulate it, the transient events themselves, the preaccident steady state, the MMS boundary conditions imposed to simulate the transient, the plant data available for comparison, and finally a comparison of transient calculations with plant data and RETRAN runs are described.

40992 (EPRI-CS/NP—3016-Vol.4B, pp 4.27-4.45) **MMS simulation of the Prairie Island Unit-1 tube rupture transient.** Dion, D.R. (Jaycor, Mt. View, CA). Apr 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920392. (CONF-8409396—Vol.4B).

From Workshop on Modular Modeling System (MMS); New Orleans, LA, USA (26 Sep 1984).

The work described is part of the prerelease effort to test and validate the Modular Modeling System (MMS) recently developed by the Electric Power Research Institute (EPRI). A steam generator tube rupture transient for a nuclear power plant was simulated on the computer to test and to validate the MMS code. The simulation results were compared to plant data and to RETRAN. Specifically, a thermal-hydraulic analysis was made of the first 430 seconds of a U-tube steam generator tube rupture that occurred at the Prairie Island Unit 1 nuclear power plant on October 2, 1979. This transient was chosen for several reasons, among these are: plant data are available for comparing and validating results as is a RETRAN simulation. In addition, many interesting thermal-hydraulic events occur during the first 430 seconds of the tube break transient and thus many aspects and capabilities of the MMS two-phase modules can be tested. Among these events are the tube rupture itself with ensuing leak from primary to secondary side, a load reduction followed by a reactor scram, repressurization using the High Pressure Safety Injection (HPSI) pumps, and a reactor coolant pump coastdown. The Modular Modeling System itself, the Prairie Island Unit 1 plant, the MMS plant model, the transient events themselves, the pretransient full power steady state, and then the boundary conditions specified during the simulation are described. An exposition of the MMS results are reported and compared to plant data and to the RETRAN results.

40993 (EPRI-CS/NP—3016-Vol.4B, pp 4.49-4.62) **Simulation of a natural circulation event with the modular modeling system.** Dion, D.R.; Sursock, J.P. (JAYCOR, San Diego, CA). Apr 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920392. (CONF-8409396—Vol.4B).

From Workshop on Modular Modeling System (MMS); New Orleans, LA, USA (26 Sep 1984).

One of the major objectives of the MMSO2 code is to simulate accident cnditions in pressurized water reactors (PWRs). Under some emergency conditions, operator guidelines call for tripping the reactor coolant pumps and then establishing natural circulation conditions. It is desirable, therefore, to test the capabilities of the MMSO2 modules in simulating the transition from forced circulation to natural circulation because natural circulation conditions will occur in a wide variety of transient scenarios. Simulation of events involving natural circulation requires special considerations since the reactor coolant flow drops to a few percent of the corresponding forced flow. Pressure drops across all components are also reduced to a few percent of normal values. If numerical instabilities show up in any thermal-hydraulic code, they may well show

up in low flow situations. Accordingly, a Loss-of-Offsite Power test was conducted on April 22, 1978, as part of the startup testing following a core reload at the Three Mile Island Unit-2 (TMI-2) nuclear power plant. The transient begins with a simultaneous reactor trip, loss of feedwater and a trip of the three operating reactor coolant pumps (the fourth was out of service for maintenance). The TMI-2 plant, the MMS model constructed to model it, the steady-state operating point at the beginning of the transient, the transient events themselves, and the boundary conditions imposed during the simulation are described. The simulation results are presented along with a discussion. All calculations were performed using the EASY5 simulation language.

40994 (EPRI-CS/NP—3016-Vol.4B, pp 4.65-4.75) **Crystal River loss of instrumentation power supply event.** Wilson, T.L. Jr. Apr 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920392. (CONF-8409396—Vol.4B).

From Workshop on Modular Modeling System (MMS); New Orleans, LA, USA (26 Sep 1984).

The transient presented in this report occurred when one of two instrumentation power supplies was lost. The PORV opened due to the loss of instrumentation power. The operators, having recently been trained on the TMI-2 accident recognized the open PORV, and closed the block valve. They continued high pressure injection according to procedures, which resulted in pressure relief through the pressurizer code safety valves. The pressurizer was eventually overfilled, and liquid was released through the safety valve. The transient also includes reactor coolant pump trip and coastdown to natural circulation and asymmetric cooldown with feedwater cooling in only one steam generator. This sequence of events provides a unique test of the capabilities of the MMS modules to simulate actual plant conditions. The plant simulated in this transient is Crystal River Unit 3, a B&W 177 fuel assembly plant. The design is nearly identical with the TMI-2 design which has been modeled for two other events. The results of this simulation include the initial state shown. The steady state results are acceptable considering the inconsistencies in between the neutron flux detectors and the heat balances on the primary and secondary. The transient results are not completely satisfactory. Work to benchmark on this transient was stopped because time and money had run out and the measured data were not complete enough to be certain of the cause of the discrepancies.

40995 (EPRI-CS/NP—3016-Vol.4B, pp 4.79-4.104) **MMS simulation of a steam line break transient.** Sjoberg, A., Sursock, J.P. Apr 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920392. (CONF-8409396—Vol.4B).

From Workshop on Modular Modeling System (MMS); New Orleans, LA, USA (26 Sep 1984).

The work described is part of the prerelease work to test and validate the Modular Modeling System (MMS). A fictitious main steam line break in a typical three loop PWR was simulated with the MMS code and the results were compared to an available RETRAN-01 analysis of the same transient. This transient was chosen for several reasons the major reason being the severity of the thermal-hydraulic events occurring during the first 50 seconds after break initiation. The sequence of events for these 50 seconds included reactor scram, reactor coolant pump coastdown, main feedwater regulation valve failure in the faulted steam generator, reverse flow check valves closed in intact steam generator feedwater line, emptying of pressurizer and initialization of high pressure safety injection flow. As the transient basically was an overcooling transient, it tested the capabilities of the pressurizer module which had to simulate the emptying of the pressurizer. It also tested MMS's abilities to simulate the phenomena occurring when steam entered the subcooled hot leg region. The comparison with RETRAN does not intend to cover all aspects of MMS validation for a steam line break transients, but is primarily intended to verify the scoping capability of the code for selected accident conditions. A brief description of the transient and sequence of events, the MMS plant model, and some discussions and comments on the MMS simulation results are presented.

40996 (EPRI-CS/NP—3016-Vol.4B, pp 5.3-5.40) **Qualification of MMSO2 with LOFT L3-7 small break LOCA.** Sursock, J.P. Apr 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920392. (CONF-8409396—Vol.4B).

From Workshop on Modular Modeling System (MMS); New Orleans, LA, USA (26 Sep 1984).

One of the major objectives of the MMSO2 code is to simulate accident conditions in PWR's. This capability has been developed over the past two years and has now reached the qualification stage. A discussion of a particular application of MMS to a small break loss of coolant event is presented. The LOFT L3-7 test simulates a cold leg break of a plant-equivalent-diameter of 1 inch (2.54 cm). The calculation was pursued for 2000 seconds after break initiation. The LOFT facility and the L3-7 test are briefly described and the MMS representation of LOFT is discussed. The key results are also presented.

40997 (EPRI-CS/NP—3016-Vol.4B, pp 5.43-5.78) **Single power region PWR reflood model for MMS.** Ghiaasiaan, S.M.; Wassel, A.T. (Science Applications International Corp., Hermosa Beach, CA). Apr 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920392. (CONF-8409396—Vol.4B).

From Workshop on Modular Modeling System (MMS); New Orleans, LA, USA (26 Sep 1984).

A model was developed to simulate bottom reflooding in pressurized water reactors. The conservation equations governing the reflood phenomena were formulated in terms of a set of ordinary differential equations compatible with the modular modeling system. The thermal-hydraulic equations were integrated using the GEAR integration package of the EASY5 simulation language. Model predictions are provided and compared with full scale experiments. The comparisons show good agreement between the model and data of the FLECHT-SEASET and SCTF experiments. Sensitivity studies were carried out investigating the effect of axial nodalization on model predictions. The reflood model when integrated with the rest of the primary coolant system will allow the calculation of the reflood phase of a PWR loss of coolant accident.

40998 (EPRI-CS/NP—3016-Vol.4B, pp 5.81-5.94) **Predication of power-flow characteristics of FIST natural circulation tests using MSS.** Abdollahian, D.A.; Elias, E.; Kalra, S.P. (S. Levy Inc., Campbell, CA). Apr 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920392. (CONF-8409396—Vol.4B).

From Workshop on Modular Modeling System (MMS); New Orleans, LA, USA (26 Sep 1984).

The BWR Full Integral Simulation Test (FIST) program was initiated in order to study the BWR thermal hydraulic response under Loss of Coolant Accident (LOCA), and operating transient conditions in a scaled BWR6/218. These tests were aimed at simulating a spectrum of BWR loss-of-inventory and operational transients. The test matrix included LOCA involving various break sizes and locations, and power transients with degraded systems. The study was initiated to evaluate the predictive capability of MMS BWR module using the results from the FIST program. A natural circulation test was selected for comparison due to limitations of the BWR module at the start of the project. The geometry, system losses, and operating characteristics of the FIST test facility were obtained and used to initialize the module. The rod bundle in these experiments was electrically heated, therefore, the neutronics and fuel temperatures sections of the module were bypassed and the power profile was inputed to the module. Seven quasi-steady natural circulation tests were performed in the FIST phase 1 test program which provided the power-flow behavior of the BWRs. The test data on only one transient is available at this time which was used for analysis in the study.

40999 (EPRI-CS/NP—3016-Vol.4B, pp 7.27-7.33) **Procedure analysis of Westinghouse emergency response guidelines for steam generator tube ruptures.** Barrett, M.J.; Donaldson, J.R. Apr 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920392. (CONF-8409396—Vol.4B).

From Workshop on Modular Modeling System (MMS); New Orleans, LA, USA (26 Sep 1984).

In the aftermath of TMI-2, the Westinghouse Owners' Group (WOG) established a procedures development program to provide generic guidance to owners of Westinghouse designed nuclear steam supply systems. This evolved through NUREG-0578, -0660, and -0737 to the WOG Emergency Response Guidelines (ERG) set that has been developed to date. The ERG set provides generic guidance for a wide range of transients and degraded conditions. Using this generic guidance, plant-specific procedures can be developed by considering the similarities and differences between the reference plant and a utility's own plant. The ERG set provides the technical background information used in developing the generic procedures. This includes, for some transients, graphs of the predicted transient response generated by Westinghouse using their computer codes. This program intends to simulate selected tube rupture transients using the Modular Modeling System (MMS) computer code and compare the results obtained to those presented in the ERG set. A good comparison should demonstrate the suitability of MMS for evaluating the adequacy of procedures. A high degree of similarity exists between the Westinghouse reference plant and the Catawba Nuclear Station modeled for this work.

41000 **(EPRI-NP—4534) Experimental studies of pipe whip and impact: Final report.** Chouard, P.; Garcia, J.L.; Sermet, E.; Anglaret, G.; Carli, F.; Ngo, B. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France); Framatome, 92 - Paris La Defense (France); Electric Power Research Inst., Palo Alto, CA (USA)). Feb 1987. 202p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920329.

An experimental and computational study was undertaken to estimate the effects of pipe rupture and induced pipe whip impact on surround structures considered either as rigid or deformative such as concrete slabs. This program included sixteen tests using 3 inch schedule 80 (or 10) pipes made of carbon steel similar to A106 grade B. The study consisted of tests on rigid target and on concrete slab. The investigation of whip phase and impact phase was done separately for each test. For pipe impact on rigid targets, the impact forces are found to be directly related to the crush strength of the pipe and the general pipe deformation following the impact. For pipe impact on concrete slabs, the response of the target to the pipe impact needs to take into account the local effect such as penetration and localized damage on the slab. The test matrix covered a broad range of geometric parameters. It provides a significant data base for studying pipe whip and impact phenomena. Apart from the experiments, illustrative calculations were made to simulate the pipe whip behavior and compute the resulting loads corresponding to experimental conditions.

41001 **(EPRI-NP—4865) Experimental studies of the seismic response of piping systems supported by multiple structures: Final report.** Kelly, J.M. (California Univ., Berkeley (USA). Dept. of Civil Engineering; Electric Power Research Inst., Palo Alto, CA (USA)). Jan 1987. 147p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920260.

An extensive series of experiments on the seismic response of a model piping system in a structure has been completed on the shaking table of the Earthquake Simulator Laboratory of the University of California, Berkeley. The purpose of these experiments was to provide data to assess the accuracy of current piping analysis methods for predicting the seismic response of multiple support piping systems. The piping system tested was a half-scale model and the structure in which it was located comprised two steel frames which could be interconnected to act as a single structure or disconnected to act as separate structures. The piping system was attached at several points to each structure and spanned the gap between the two. This report describes the experimental program, the results of which are presented in several forms - extreme values, time histories, floor response spectra and Fourier spectra. Examples of these are given and the response of the piping system when the two frame structures are braced together to act as a single unit is compared to that when the structures are unbraced and act independently. The response of the piping system when rod hangers only are used is compared to that when rods and snubbers, rods and springs, are used in combination. The response of the supports during seismic loading is illustrated by time history plots and by hysteresis plots of force-displacement characteristics under dynamic conditions.

41002 **(EPRI-NP—5250M) Emergency Operating Procedures Tracking System: Interim report.** Petrick, W.; Ng, K.B. (Nuclear Software Services, Inc., Los Gatos, CA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jun 1987. 136p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920483.

This interim report describes the work performed in the Emergency Operating Procedure Tracking System project through December 1986. An Executive Summary (Part I) provides a high level description of the application and project task description; Functional Specifications (Part II) and Detailed Design Specifications (Part III) give a detailed description of the form and function of the Emergency Operating Procedure Tracking System software. Appendices containing a complete compilation of the rules logic, output messages and version of the Kuo Sheng plant emergency operating procedures are used as a source in the full prototype implementation.

41003 **(EPRI-NP—5254) Effectiveness of thermal ignition devices in rich hydrogen-air-steam mixtures: Final report.** Tamm, H.; Ungurian, M.; Kumar, R.K. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment; Electric Power Research Inst., Palo Alto, CA (USA)). Jul 1987. 48p. (AECL—8363). Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920518.

Deliberate ignition of hydrogen with glow plug ignitors is one method of mitigating the possible effects of a hydrogen burn on containment integrity in potential reactor accidents. Since these accidents may produce substantial amounts of steam, experiments have been performed to determine the hydrogen-air-steam regimes for which these ignitors would be effective. Previous work examined the effectiveness of the GM AC 7G thermal glow plug and the Tayco model 3442 ignitor with hydrogen-lean mixtures. This report presents the results of tests with the GM AC 7G glow plug ignitor: (a) in the hydrogen-rich regime; and (b) in steam-condensing atmospheres.

41004 **(EUR—10184-Vol.1) Phased mission methodology. A state-of-the-art report: Parts A, B and C.** Terpstra, K.; Van Driel, G. (Commission of the European Communities, Luxembourg). 1986. 191p. NTIS (US Sales Only), PC A09/MF A01. File Number DE87752285.

A complex system has to perform a number of different tasks. Sometimes these tasks must be performed at the same time, but in a lot of cases the system has to perform its tasks subsequently. The execution of the different tasks is effected by parts of the system, so-called subsystems more or less dependent by means of processes and/or shared equipment. Examples of such complex systems can be found, for instance, in modern space travel, in nuclear power plants, in military weapon systems, etc. A phased mission is a task for a complex system to be performed in parts (subtasks), one part after the other. The present report covers the work carried out under the tripartite concert between the European Communities (CEC), the Gesellschaft fuer Reaktorsicherheit mbH (GRS) and the Netherlands Energy Research Foundation (ECN). The scope of the studies is to assess the practical usefulness of phased mission analyses. The present volume consists of three parts: Part A: Phased mission analysis. A review of mathematical modelling and of a number of existing computer programs; Part B: Example for the application of phased mission methods in reliability and risk studies; and, Part C: Calculation results for a phased mission - Part C1 - Phased mission calculation for a reference heat removal system - Part C2 - Application of phased mission methods in reliability and risk studies.

41005 **(EUR—10184-Vol.2) Phased mission methodology. A State-of-the-Art Report: Annexes 1, 2 and 3.** Terpstra, K.; Van Driel, G.; Kafka, P.; Polke, H. (Commission of the European Communities, Luxembourg). 1986. 90p. NTIS (US Sales Only), PC A05/MF A01. File Number DE87752295.

This volume includes the annexes 1, 2 and 3 of the report EUR 10184 EN/I.

41006 **(EUR—10420) Sensitivity of LMFBR containment response to the parameters of a HCDA situation.** Fabry, J.P.; Renard, A.; Washby, V.; Yerkess, A.; Benuzzi, A. (Commission of the European Communities, Ispra (Italy). Joint Research Centre; Commission of the European Communities, Luxembourg). 1986. 17p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87752296.

A synthesis of a lot of theoretical and experimental results is presented pointing out the sensitivity of some selected results to important parameters. A sensitivity study is defined for a real reactor size layout, which is now in progress; a first result of the reference case is given.

41007 **(EUR—10429) Sensitivity analysis of Seurbnuk/Eurdyn predictions concerning a LMFBR primary containment problem.** Benuzzi, A.; Yerkess, A.; Merlini, S. (Commission of the European Communities, Ispra (Italy). Joint Research Centre; Commission of the European Communities, Luxembourg). 1986. 72p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87752297.

The results of a nonlinear sensitivity analysis performed on the predictions made by the Primary Containment code SEURBNUK/EURDYN concerning a typical pool-type Liquid Metal Fast Breeder Reactor undergoing a Core Disruptive Accident, are presented and discussed. The sensitivity of the computed responses representing the roof loading and vessel deformation processes have been determined, considering the effects of variations imposed to the energy released by the expanding core bubble, to its initial pressure, to the roof mass, to the cover gas gap, to the yield stress and to the plastic modulus of the stainless steel adopted. To reach this goal it has been necessary to perform a series of 28 computer code calculations. The spread of the computer code responses due to the prescribed parameter variations (single and coupled) has been determined. The relative importance of the parameters in producing response variations has been assessed and a hierarchy in the parameters has been established. The computer code responses have shown in general a limited sensitivity to the prescribed parameter variations and a nonlinear behaviour in the neighbourhood of the nominal point in the parameters space. Finally, a response surface of the code has been established.

41008 **(EUR—10519) Development of economical decontamination processes.** Lasch, M. (Commission of the European Communities, Luxembourg). 1986. 148p. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE87752286.

The activity inventary of the Nuclear Power Plant Gundremmingen (BWR, 250 MW/sub el/) had been investigated. In the turbine hall, reactor annulus and auxiliary building two years after shut down a remaining activity of 3.5 E10 Bq was found. The main nuclide was Cobalt 60 which is accounting for more than 70% of the total activity. The different decontamination methods were proved by laboratory tests on originally contaminated pipe samples. With respect to high efficiency, minimizing secondary waste and easy handling, the electrochemical decontamination proved to be the most economical decontamination method. This decontamination procedure had been tested on primary steam valves and the feedwater pumps. 10-20 manhours were needed for the decontamination of each ton of material. The specific secondary waste amount was 95 kg per ton of steel. Those figures were evaluated for the dismantling of a 250 MW/sub el/ Boiling Water Reactor (except of the containment). After the decontamination of 3400 tons of metal about 260 tons of secondary waste will remain. The dismantling will need 5.9 years. The same evaluation has been performed too for a 1300 MW/sub el/ Boiling Water Reactor.

41009 **(EUR—10584) Steam condensation modelling in aerosol codes.** Dunbar, I.H. (Commission of the European Communities, Luxembourg). 1986. 75p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87752287.

The principal subject of this study is the modelling of the condensation of steam into and evaporation of water from aerosol particles. These processes introduce a new type of term into the equation for the development of the aerosol particle size distribution. This new term faces the code developer with three major problems: the physical modelling of the condensation/evaporation process, the discretisation of the new term and the separate accounting for the masses of the water and of the other components. This study has considered four codes which model the condensation of steam into and its evaporation from aerosol particles: AEROSYM-M (UK), AEROSOLS/B1 (France), NAUA (Federal Republic of Germany) and CONTAIN (USA). The modelling in the codes has been addressed under three headings. These are the physical modelling of condensation, the mathematics of the discretisation of the equations, and the methods for modelling the separate behaviour of different chemical components of the aerosol. The codes are least advanced in area of solute effect modelling. At present only AEROSOLS/B1 includes the effect. The effect is greater for more concentrated solutions. Codes without the effect will be more in error (underestimating the total airborne mass) the less condensation they predict. Data are needed on the water vapour pressure above concentrated solutions of the substances of interest (especially CsOH and CsI) if the extent to which aerosols retain water under superheated conditions is to be modelled. 15 refs.

41010 **(EUR—10586) Comparison of the methods of seismic analysis applicable to fast reactors in the EEC countries.** Defalque, M.; Kunsch, P.; Preumont, A. (Commission of the European Communities, Luxembourg). 1986. 71p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87752288.

Also published in French.

The countries in the Community which are concerned by this study are those currently involved in the operation or development of fast reactors, namely: FRANCE (Phenix - Superphenix), FRG - BELGIUM - THE NETHERLANDS associated within DeBeNe (SNR - 300), UNITED KINGDOM (UK) (PFR-CDFR), ITALY (PEC). The first aim of the study is to enumerate the common points and differences in the national rules and regulations for the seismic analysis of fast breeder reactors. Such divergences may be encountered at different design stages, namely: in the definition of the seismic input data, in the choice of design limits and in the degree of conservatism applied to the calculation methods employed. For every one of these three stages, it is necessary to identify the points likely to influence the results of the analysis and consequently the over-all safety margin with regard to the event concerned. 73 refs.

41011 **(EUR—10643) State-of-the-Art review on technology for measuring and controlling very low level radioactivity in relation to the decommissioning of nuclear power plants.** Hulot, M.; Chapuis, A.M.; Garbay, H.; Jager, W.; Kroeger, J. (Commission of the European Communities, Luxembourg). 1986. 134p. NTIS (US Sales Only), PC A07/MF A01. File Number DE87752291.

Information in relation to the measurement devices for very low radioactivity, applied in the decommissioning of electronuclear power plants, is scarce and scattered. However, some realistic information can be obtained from the specialists working on nuclear plant dismantling sites. In practice, the in situ measurements deal with two or three radionuclides only. The other containments must be determined on some samples in laboratories by means of radioanalysis and spectrometry technologies. These technologies are briefly described. One of the problems concerns the detection threshold of the measuring instruments. This threshold varies in relation with the detector efficiency, the background and the measurement duration. The application of this concept of threshold to various types of instrument is studied. Tables and graphs are given that sum up the various possibilities of detection for the usual detectors according to their effective area. The possibility of reducing the number of monitoring points using statistical methods is presented.

41012 **(EUR—10707) Evaluation of the Community's nuclear reactor safety research programme.** Brandstetter, A.; Goedkoop, J.A.; Jaumotte, A.; Malhouitre, G.; Tomkins, B.; Zorzoli, G.B. (Commission of the European Communities, Luxembourg). 1986. 302p. NTIS (US Sales Only), PC A14/MF A01. File Number DE87752292.

This report describes an evaluation of the 1980-85 CEC reactor safety programme prepared, at the invitation of the Commission, by a panel of six independent experts by means of examining the relevant document and by holding hearings with the responsible CEC staff. It contains the recommendations made by the panel on the following topics: the need for the JRC to continue to make its competence in the reactor safety field available to the Community; the importance of continuity in the JRC and shared-cost action programmes; the difficulty of developing reactor safety research programmes which satisfy the needs of users with diverse needs; the monitoring of the utilization of the research results; the maintenance of the JRC computer codes used by the Member States; the spin-off from research results being made available to other industrial sectors; the continued contact between the JRC researchers and the national experts; the coordination of LWR safety research with that of the Member States; and, the JRC work on fast breeders to be planned with regard to the R and D programmes of the Fast Reactor European Consortium.

41013 **(EUR—10740) Community's research and development programme on decommissioning of nuclear installations: First annual progress report (year 1985).** (Commission of the European Communities, Luxembourg). 1986. 147p. NTIS (US Sales Only), PC A07/MF A01. File Number DE87752293.

This is the first Annual Progress Report of the European Community's 1984-88 programme of research on the decommissioning of nuclear installations. It shows the status of implementation reached on 31 December 1985. The 1984-88 programme has the following contents: A. Research and development projects concerning the following subjects: Project No 1: Long-term integrity of building and systems; Project No 2: Decontamination for decommissioning purposes; Project No 3: Dismantling techniques; Project No 4: Treatment of specific waste materials: steel, concrete and graphite; Project No 5: Large containers for radioactive waste produced in the dismantling of nuclear installations; Project No 6: Estimation of the quantities of radioactive wastes arising from the decommissioning of nuclear installations in the Community; Project No 7: Influence of installation design features on decommissioning. B. Identification of guiding principles, namely: - certain guiding principles in the design and operation of nuclear installations with a view to simplifying their subsequent decommissioning, - guiding principles in the decommissioning of nuclear installations which could form the initial elements of a Community policy in this field. C. Testing of new techniques under real conditions, within the framework of large-scale decommissioning operations undertaken in Member States. This first progress report, covering the period of putting the programme into action, describes the work to be carried out under the 27 research contracts concluded, as well as initial work performed and first results obtained.

41014 **(GR—86-10) Intervention levels for nuclear reactor accidents.** (Gezondheidsraad, The Hague (Netherlands)). 3 Sep 1986. 159p. (In Dutch). NTIS (US Sales Only), PC A08/MF A01. File Number DE87702717.

In the Netherlands emergency plans have been drawn up for accidents with Dutch reactors and reactors situated just beyond the country's frontiers. The emergency plans contain intervention levels, i.e. decision criteria for the implementation of certain countermeasures. These intervention levels are based on recommendations made by the Health Council of the Netherlands, published in 1975. The present report revises those recommendations in view of the new recommendations of the International Commission on Radiological Protection (ICRP-Publication 26, issued in 1977). The intervention levels are now specified with respect to the most important countermeasures, which are evacuation, sheltering, iodine prophylaxis and restriction of comsumption of foodstuffs and water. For each countermeasure a range of intervention levels is proposed. The lower IL for the less severe countermeasure is related to the annual dose limit for members of the public given in the Euratom basic safety standards. The upper IL for evacuation is determined by the principle of preventing non-stochastic effects. A range of 5 to 50 mSv for sheltering and restriction of food and water intake and to 50 to 500 mSv for evacuation is recommended based on the dose equivalent in the whole body. In terms of dose equivalents for the thyroid the IL range for evacuation is 250 to 1500 mSv and for the less severe countermeasures 50 to 250 mSv. 63 references, 16 figures, 10 tables.

41015 (IAEA-TECDOC—382, pp 223-244) **Nuclear civil liability in the Spanish legislation.** Corretjer, L. (Junta de Energia Nuclear, Madrid, Spain). Oct 1986. (In Spanish). NTIS (US Sales Only), PC A16/MF A01. File Number DE87702732. (CONF-8410472—).

From Regional course on legislation and regulation of nuclear safety for Latin American countries; Montevideo, Uruguay (15 Oct 1984).

Civil liability for nuclear damage in the Spanish legislation is analysed. The influence of international conventions on this regime and the new elements introduced by the 1964 Nuclear Energy Act are discussed.

41016 (IAEA-TECDOC—382, pp 245-247) **World survey of the status, problems and perspectives of nuclear insurance and re-insurance arrangements.** Oct 1986. (In Spanish). NTIS (US Sales Only), PC A16/MF A01. File Number DE87702732. (CONF-8410472—).

From Regional course on legislation and regulation of nuclear safety for Latin American countries; Montevideo, Uruguay (15 Oct 1984).

This report by the British Insurance (Atomic Energy) Committee provides comprehensive information on the development and current situation of the nuclear insurance market. A worldwide list of nuclear insurance pools is also provided.

41017 **(IAEA-TECDOC—400) Probabilistic safety assessment for research reactors.** (International Atomic Energy Agency, Vienna (Austria)). Dec 1986. 119p. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702733.

Increasing interest in using Probabilistic Safety Assessment (PSA) methods for research reactor safety is being observed in many countries throughout the world. This is mainly because of the great ability of this approach in achieving safe and reliable operation of research reactors. There is also a need to assist developing countries to apply Probabilistic Safety Assessment to existing nuclear facilities which are simpler and therefore less complicated to analyse than a large Nuclear Power Plant. It may be important, therefore, to develop PSA for research reactors. This might also help to better understand the safety characteristics of the reactor and to base any backfitting on a cost-benefit analysis which would ensure that only necessary changes are made. This document touches on all the key aspects of PSA but placed greater emphasis on so-called systems analysis aspects rather than the in-plant or ex-plant consequences.

41018 **(INIS-BR—604) Preliminary report about nuclear accident of Chernobylsk reactor.** Oliveira, A.R. de. (NUCLEOS, Rio de Janeiro (Brazil). Area de Saude). Jul 1986. 50p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. File Number DE87702593.

The preliminary report of nuclear accident at Chernobyl, in URSS is presented. The Chernobyl site is located geographically and the RBMK type reactors - initials of Russian words which mean high power pressure tube reactors are described. The conditions of reactor operation in beginning of accident, the events which lead to reactor destruction, the means to finish the fire, the measurements adopted by Russian in the accident location, the estimate of radioactive wastes, the meteorological conditions during the accident, the victims and medical assistence, the sanitary aspects and consequences for population, the evaluation of radiation doses received at small and medium distance and the estimate of refered doses by population attained are presented. The official communication of Russian Minister Council and the declaration of IAEA general manager during a collective interview in Moscou are annexed.

41019 **(INIS-mf—9940) Decree No. 84-930 of 17 October 1984 publishing an Agreement between the governments of France and Luxembourg on exchange of information in case of incident or accident which may have radiological consequences, signed in Luxembourg on 11 April 1983.** (International Atomic Energy Agency, Vienna (Austria)). 20 Oct 1984. 2p. (In French). NTIS (US Sales Only), PC A02/MF A01. File Number DE87780142.

This Agreement between France and Luxembourg provides for the setting up of an appropriate system for the Parties to be mutually informed without delay of any incident or accident occurring in either of their territories, likely to affect the territory of the other state, in particular, those which may occur in a nuclear power plant and which might have radiological consequences.

41020 **(INIS-mf—10666) Chernobyl reactor accident and its effects with regard to surface waters and the drinking water supply in the Land North-Rhine Westphalia.** (Landesamt fuer Wasser und Abfall Nordrhein-Westfalen, Duesseldorf (Germany, F.R.)). Jun 1986. 10p. (In German). NTIS, PC E07; Available from NTIS as TIB/B87-09339.

LWA-Sonderbericht.

After a general survey of the aerosol activity in North-Rhine Westphalia (NRW) due to the Chernobyl fallout, the report explains the effects on soil, surface waters, fish, sediments, and the drinking water. Finally, an assessment of the radiation exposure of the population resulting from the surface water contamination in NRW is presented.

41021 **(INIS-mf—10912) Lucas Heights buffer zone: plan of management.** (Australian National Parks and Wildlife Service, Sydney). 1986. 96p. NTIS (US Sales Only), PC A05/MF A01. File Number DE87702785.

This plan is being used by the Commission as a guide for its management of the Lucas Heights buffer zone, which is essentially a circular area having a 1-6 km radius around the HIFAR reactor. Aspects covered by this plan include past uses, current use, objectives for buffer zone land management, emergency evacuation, resource conservation, archaeology, fire, access, rehabilitation of disturbed areas, resource management and plan implementation.

41022 **(JAERI-M—86-140) MUTUAL: a computer code for analysing nuclear criticality safety on array system.** Naito, Y.; Okuno, H.; Kaneko, T. (Japan Atomic Energy Research Inst., Tokyo). Sep 1986. 43p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87702623.

For evaluating critical safety on array system, the solid angle method is often used as a simple method. There are, however, some demerits in the method: the effective multiplication factor of the system cannot be known and it is excessively overestimated under certain circumstances. Therefore a new method has been developed to obtain the effective multiplication factor of array system simply. In this method, neutron transportation being expressed in terms of solid angles between units arranged in the system, and effects of shadow caused by other units and effects of neutron reflection by the wall being taken into account, the eigen equation is solved and the effective multiplication factor is obtained. A computer code MUTUAL has been programmed according to this method. This report is a user's manual for the MUTUAL code.

41023 **(JAERI-M—86-142) Application of the SPEEDI system to the Chernobyl reactor accident.** Chino, M.; Ishikawa, H.; Yamazawa, H.; Moriuchi, S. (Japan Atomic Energy Research Inst., Tokyo). Oct 1986. 69p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87702625.

The SPEEDI system is a computational code system to predict the radiological dose due to the plume released in a nuclear accident in Japan. This paper describes the SPEEDI's application to the Chernobyl reactor accident for the estimation of the movement of plume and the release rate of radioactive nuclides into the environment. The predicted results on the movement of plume agreed well with the monitoring data in Europe. The estimated results on the release rate showed that half of the noble gas inventory, about 5% of the iodine inventory and about 3% of the cesium inventory are released into the environment within 24 hours.

41024 **(JAERI-M—86-158) HORN: a computer code to analyze the gas-phase transport of fission products in reactor cooling system under severe accidents.** Uchida, M.; Saito, H. (Japan Atomic Energy Research Inst., Tokyo). Nov 1986. 62p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87702638.

A computer code HORN has been developed to calculate the transport of volatile fission products in dry primary cooling circuit under severe accidents of water reactors. This report describes the analytical models of the code. As the most important factor governing the release or deposition of fission product, HORN determines the chemical forms of fission products both in the bulk flow and at the wall by the gas-liquid-solid equilibrium model. The results are used to calculate the diffusional deposition rates of vapors and to estimate the nucleation rates of aerosols. Efforts have been made to minimize the number of fission product elements for analysis by using the periodicity of elements and by treating less-volatile elements collectively as an imaginary element which always behaves as aerosols. The elements that are considered in the present version either as carrier gas or as elements for analysis are H, O, B, Kr, Xe, Cs, I, Te, Sb, Ag, Cd, and Ba.

41025 **(Juel—2103) Nuclear power plants near consumers from a safety-engineering point of view. An analysis including modern probabilistic approaches and a suggestion for appropriate safety requirements.** Kroeger, W. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Nukleare Sicherheitsforschung; Wuppertal Univ. (Gesamthochschule) (Germany, F.R.)). Nov 1986. 187p. (In German). NTIS, PC E14; Available from NTIS as TIB/B87-09390.

Special safety requirements must be met by a nuclear power station near the consumer. These requirements may not be formulated in a purely probabilistic way because of the methodological deficiencies identified. The existing protection concept is rather extended so as to include the requirement of engineered safeguards in order to limit the damage in case of a worst reactor accident. The suggested individual dose limit together with the calculation rules should ensure that the consequences of a worst accident are essentially limited to the plant and that no emergency protection measures and countermeasures need to be considered either in the short term or in the longer term to prevent health damage. The resulting features of a reactor near the consumer aim at better inherent safety characteristics, which is shown to be possible by reasonable technical means and which seems to have already been realized to a large extent in plants of small and perhaps also medium power already conceived. The way of thinking behind this suggestion is applicable to other sectors of industrial technology. Furthermore, it might serve as a basis in the discussion about general advanced safety criteria, which has been stimulated due to 'Chernobyl'.

41026 **(Juel-Spez—374) THERAPIE - THErmix-RAps-Plot-InterfacE. A graphic software for representation of THERMIX-2D results with the interactive plot program RAPS.** Duensing, P.; Jahn, W.; Rehm, W. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Nukleare Sicherheitsforschung). Sep 1986. 86p. (In German). NTIS, PC E09; Available from NTIS as TIB/B87-07732.

The performance of safety analyses for gas-cooled high temperature reactor power plants requires efficient plot codes for the evaluation and representation of computer results. The report describes the coupling between the thermodynamic simulation code THERMIX and the graphic plot code RAPS via the interface program THERAPIE. Especially the structure and the handling of the interface program are explained as well as the dialogue with the plot code. Further options of the colour graphic system are demonstrated for the representation of temperature distributions in components of HTR concepts (HTR-500).

41027 **(KFKI—1986-87/G) Failure of the main circulation pump in the Paks Nuclear Power Plant.** Ezsoel, Gy.; Maroti, L. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). Dec 1986. 20p. (In Hungarian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702844.

A method is presented for the calculation of the coolant flowrate in the primary loops with open or closed gate valves considering the failure of some loops at the Paks Nuclear Power Plant. The influence of the deviations in the pump performances on the cooling circumstances was also investigated. 7 tables.

41028 **(LA-UR—87-116) Study of the hovering period and bubble size in fully developed pool nucleate boiling of saturated liquid with a time-dependent heat source.** Pasamehmetoglu, K.O.; Nelson, R.A. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 15p. (CONF-870816—5). NTIS, PC A02/MF A01; GPO Dep. File Number DE87005110.

From 24. national heat transfer conference and exhibition; Pittsburgh, PA, USA (9 Aug 1987).

In this paper, the bubble behavior in saturated pool boiling with a time-dependent heat source is analyzed. The study is restricted to the period from fully developed nucleate boiling until critical heat flux occurs. The hovering period and the departure volume of the bubble are selected as the characteristic parameters for bubble behavior. These parameters are quantified by solving the equation of motion for an idealized bubble. This equation is solved for cases in which the surface heat flux changes linearly and exponentially as a function of time. After nondimensionalization, the results are compared directly with the results of the steady-state problem. The comparison shows that the transient heat input has practically no effect on the hovering period. However, the transient heat flux causes a decreased volume at bubble departure. The volume decrease is dependent on the severity of the transient. These results are in qualitative agreement with the experimental observation quoted in the literature.

41029 **(LA-UR—87-118) Transient direct-contact condensation on liquid droplets.** Pasamehmetoglu, K.O.; Nelson, R.A. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 24p. (CONF-870816—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87005108.

From 24. national heat transfer conference and exhibition; Pittsburgh, PA, USA (9 Aug 1987).

In this paper, direct-contact condensation on subcooled liquid droplets is studied in two parts. In the first part, simple design correlations for the condensation in a steady environment are developed based upon a conduction model. These correlations include the convective heat-transfer coefficient, condensation rate, total condensation, and the droplet-thermalization time. In the second part of the paper, the effect of a time-dependent saturation temperature on the condensation process is investigated. A rapid decrease in saturation temperature is typical of condensation environments in which the steam-supply rate is limited and condensation-induced depressurization becomes important. Design correlations are developed for condensation in an environment in which the saturation temperature decreases linearly with time. These correlations are graphically compared to the design correlations of the first part through a quasi-steady approach. The error associated with this approach is quantified as a function of the rate of change of the saturation temperature.

41030 **(LA-UR—87-167) Integrated TRAC/MELPROG analyses of a PWR station blackout.** Henninger, R.; Dearing, J.F. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 20p. (CONF-870816—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87005102.

From 24. national heat transfer conference and exhibition; Pittsburgh, PA, USA (9 Aug 1987).

The first complete, coupled, and largely mechanistic analysis of the entire reactor-coolant system during a station blackout (TMLB') core-meltdown accident has been made with MELPROG/TRAC. The calculation was initiated at the start of the transient and ended with a late recovery of cooling. Additional cooling provided by water from the primary system delayed events relative to a standalone MELPROG calculation. Natural circulation within the vessel was established and primary-relief-valve action did little to disturb this flow. In addition, it was calculated directly that the hot leg reached a failure temperature long before vessel failure. Beyond relocation of the core, we have calculated the boiloff of the water in the lower head and have estimated the time of vessel failure to be at about 14,700 s into the transient. For "nominal" corium-water heat transfer, the boiloff process (steam-production rate) is slow enough that the relief valves prevent pressurization beyond 17.5 MPa. Parametric cases with increased corium-water heat transfer resulted in steaming rates beyond the capability of the relief valves, leading to pressures in excess of 19.2 MPa. Natural convection flow around the loop, if started by removing the water in the loop seal, was blocked by a relatively less-dense hydrogen/steam mixture that flowed to the top of the steam generator. Emergency core-cooling system activation late in the transient (after core slump) resulted in rapid cooling of the periphery of the debris region but slower cooling in the interior regions because of poor water penetration.

41031 **(LA-UR—87-1412) Comparison of steam-generator liquid holdup and core uncovery in two facilities of differing scale.** Motley, F.; Schultz, R. (Los Alamos National Lab., NM (USA); Idaho National Engineering Lab., Idaho Falls (USA)). 1987. Contract W-7405-ENG-36. 20p. (CONF-870816—14). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009010.

From 24. national heat transfer conference and exhibition; Pittsburgh, PA, USA (9 Aug 1987).

This paper reports on Run SB-CL-05, a test similar to Semiscale Run S-UT-8. The test results show that the core was uncovered briefly during the accident and that the rods overheated at certain core locations. Liquid holdup on the upflow side of the steam-generator tubes was observed. After the loop seal cleared, the core refilled and the rods cooled. These behaviors were similar to those observed in the Semiscale run. The Large-Scale Test Facility (LSTF) Run SB-CL-06 is a counterpart test to Semiscale Run S-LH-01. The comparison of the results of both tests shows similar phenomena. The similarity of phenomena in these two facilities build confidence that these results can be expected to occur in a PWR. Similar holdup has now been observed in the 6 tubes of Semiscale and in the 141 tubes of LSTF. It is now more believable that holdup may occur in a full-scale steam generator with 3000 or more tubes. These results confirm the scaling of these phenomena from Semiscale (1/1705) to LSTF (1/48). The TRAC results for SB-CL-05 are in reasonable agreement with the test data. TRAC predicted the core uncovery and resulting rod heatup. The liquid holdup on the upflow side of the steam-generator tubes was also correctly predicted. The clearing of the loop seal allowed core recovery and cooled the overheated rods just as it had in the data. The TRAC analysis results of Run SB-CL-05 are similar to those from Semiscale Run S-UT-8. The ability of the TRAC code to calculate the phenomena equally well in the two experiments of different scales confirms the scalability of the many models in the code that are important in calculating this small break.

41032 **(NUREG—0090-Vol.9-No.2) Report to Congress on abnormal occurrences, April-June 1986.** (Nuclear Regulatory Commission, Washington, DC (USA). Office for Analysis and Evaluation of Operational Data). Jan 1987. 64p. NTIS, PC A04/MF A01 - GPO. File Number TI87900520.

Section 208 of the Energy Reorganization Act of 1974 identifies an abnormal occurrence as an unscheduled incident or event which the Nuclear Regulatory Commission determines to be significant from the standpoint of public health or safety and requires a quarterly report of such events to be made to Congress. This report covers the period from April 1 to June 30, 1986. The report states that for this reporting period, there were two abnormal occurrences at the nuclear power plants licensed to operate. One involved an out of sequence control rod withdrawal and the other involved a boiling water reactor emergency core cooling system design deficiency. There were five abnormal occurrences at the other NRC licensees. Two involved willful failure to report diagnostic medical misadministrations to the NRC; one involved a therapeutic medical misadministration; and two involved diagnostic medical misadministrations. There were two abnormal occurrences reported by the Agreement States. One involved an uncontrolled release of krypton-85 to an unrestricted area; the other involved a contaminated radiopharmaceutical used in diagnostic administrations. The report also contains information updating some previously reported abnormal occurrences.

41033 (NUREG—0683-Suppl.2-Final) **Programmatic Environmental Impact Statement related to decontamination and disposal of radioactive wastes resulting from March 28, 1979 accident at Three Mile Island Nuclear Station, Unit 2 (Docket No. 50-320): Final report.** (GPU Nuclear Corp., Middletown, PA (USA); Nuclear Regulatory Commission, Washington, DC (USA)). Jun 1987. 357p. NTIS, PC A06 - GPO. File Number DE87900880.

In accordance with the National Environmental Policy Act, the Commission's implementing regulations, and the Commission's April 27, 1981 Statement of Policy, the Programmatic Environmental Impact Statement related to decontamination and disposal of radioactive wastes resulting from March 28, 1979, accident Three Mile Island Nuclear Station, Unit 2 NUREG-0683 (PEIS) is being supplemented. This supplement updates the environmental evaluation of accident-generated water disposal alternatives published in the PEIS, utilizing more complete and current information. Also, the supplement includes a specific environmental evaluation of the licensee's proposal for water disposition. Although no clearly preferable water disposal alternative was identified, the supplement concluded that a number of alternatives could be implemented without significant environmental impact. The NRC staff has concluded that the licensee's proposed disposal of the accident-generated water by evaporation will not significantly affect the quality of the human environment. Further, any impacts from the disposal program are outweighed by its benefits.

41034 (NUREG—1002-Suppl.4) **Safety Evaluation report related to the operation of Braidwood Station, Units 1 and 2 (Docket Nos. STN 50-456 and STN 50-457).** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Jul 1987. 22p. NTIS, PC A02/MF A01 - GPO. File Number TI87900900.

In November 1983, the staff of the Nuclear Regulatory Commission issued its Safety Evaluation Report (NUREG-1002) regarding the application filed by the Commonwealth Edison Company, as applicant and owner, for a license to operate Braidwood Station, Units 1 and 2 (Docket Nos. 50-456 and 50-457). The first supplement to NUREG-1002 was issued in September 1986; the second supplement to NUREG-1002 was issued in October 1986; the third supplement to NUREG-1002 was issued in May 1987. This fourth supplement to NUREG-1002 reports the status of certain items that remained unresolved at the time Supplement 3 was published. The facility is located in Reed Township, Will County, Illinois.

41035 (NUREG—1047-Suppl.6) **Safety Evaluation Report related to the operation of Nine Mile Point Nuclear Station, Unit No. 2 (Docket No. 50-410).** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Jul 1987. 61p. NTIS, PC A04/MF A01 - GPO. File Number TI87900886.

This report supplements the Safety Evaluation Report (NUREG-1047, February 1985) for the application filed by Niagara Mohawk Power Corporation, as applicant and co-owner, for the license to operate Nine Mile Point Nuclear Station, Unit 2 (Docket No. 50-410). It has been prepared by the Office of Nuclear Reactor Regulation of the US Nuclear Regulatory Commission. The facility is located near Oswego, New York. This report supports the issuance of the full-power license for Nine Mile Point Nuclear Station, Unit No. 2.

41036 (NUREG—1265, pp 2.1-2.37) **Natural circulation in reactor coolant system.** Han, J.T. May 1987. NTIS, PC A09/MF A01 - GPO. File Number TI87900729.

In Uncertainty papers on severe accident source terms.

Reactor coolant system (RCS) natural circulation in a PWR is the buoyancy-driven coolant circulation between the core and the upper-plenum region (in-vessel circulation) with or without a countercurrent flow in the hot leg piping between the vessel and steam generators (ex-vessel circulation). This kind of multidimensional bouyancy-driven flow circulation serves as a means of transferring the heat from the core to the structures in the upper plenum, hot legs, and possibly steam generators. As a result, the RCS piping and other pressure boundaries may be heated to high temperatures at which the structural integrity is challenged. RCS natural circulation is likely to occur during the core uncovery period of the TMLB' accident in a PWR when the vessel upper plenum and hot leg are already drained and filled with steam and possibly other gaseous species. RCS natural circulation is being studied for the Surry plant during the TMLB' accident in which station blackout coincides with the loss of auxiliary feedwater and no operator actions. The effects of the multidimensional RCS natural circulation during the TMLB' accident are discussed.

41037 (NUREG—1265, pp 3.1-3.23) **In-vessel core metal progression and hydrogen generation.** Wright, R.W. May 1987. NTIS, PC A09/MF A01 - GPO. File Number TI87900729.

In Uncertainty papers on severe accident source terms.

In-vessel core melt progression concerns the state of the reactor core from the start of core uncovery to reactor vessel failure. Included are the thermal attack by the core debris upon the reactor structure and the reactor vessel and in-vessel hydrogen generation. Related phenomena are in-vessel natural convection and heat transfer, in-vessel fission product and aerosol transport, and explosive and nonexplosive in-vessel rapid steam generation. The significant output information from core melt progression includes hydrogen generation and its time dependence; the mode of vessel failure; and the state of the core debris at the time of vessel failure, including the debris mass, the debris temperature, spatial, and composition distributions, and the melt distribution within the debris. These phenomena are discussed.

41038 (NUREG—1265, pp 4.1-4.24) **High-pressure melt ejection.** Lee, T.M. May 1987. NTIS, PC A09/MF A01 - GPO. File Number TI87900729.

In Uncertainty papers on severe accident source terms.

In certain reactor accidents, such as those initiated by station blackout or a small-break loss-of-coolant accident (LOCA), degradation of the reactor core can take place while the reactor coolant system remains pressurized. Left unmitigated, core melt will slump and collect at the bottom of the reactor vessel. After boiling off the remaining water in the vessel, molten core materials will start attacking the bottom head of the reactor. When the bottom head of the reactor vessel is breached in such accidents, the core melt will be ejected under pressure. The ejected materials are likely to be dispersed out of the reactor cavity surrounding containment volumes as fine particles, quickly, transferring thermal energy to the containment atmosphere. In addition, metallic components of the sprayed core debris, mostly zirconium and steel, can react with oxygen and steam in the atmosphere to generate a large quantity of chemical energy, heating and pressurizing the containment still further. The term direct containment heating (DCH) is used in this discussion to describe this complicated physical and chemical process. A description of past, present, and future research on this phenomena is presented along with an evaluation of the technical uncertainty.

41039 (NUREG—1265, pp 5.1-5.38) **Core-concrete interactions.** Burson, S.B. May 1987. NTIS, PC A09/MF A01 - GPO. File Number TI87900729.

In Uncertainty papers on severe accident source terms.

In those accident scenarios in which the reactor vessel fails, high-temperature core debris may fall into the reactor cavity where it interacts with structural concrete. The consequences of these thermal and chemical core-concrete interactions may significantly impact containment loading, the mode of containment failure, and the radiological source term. The prediction of potential risk-related consequences of core-concrete interactions and quantification of the uncertainties associated with them are discussed.

41040 (NUREG—1265, pp 6.1-6.20) **Hydrogen combustion.** Worthington, P. May 1987. NTIS, PC A09/MF A01 - GPO. File Number TI87900729.

In Uncertainty papers on severe accident source terms.

The major concern regarding hydrogen in LWRs is that the static or dynamic pressure loads from combustion may cause a breach of containment or that important safety-related equipment may be damaged because of either pressure loads or high temperatures. In order to assess the possible threats to containment and safety-related equipment and to understand the influence of hydrogen on reactor safety, knowledge of the following phenomena is re-

quired: (1) hydrogen transport and mixing, (2) ordinary deflagration, (3) flame acceleration and transition from deflagration to detonation (DDT), (4) detonations, (5) diffusion flames, (6) mitigation concepts, and (7) thermal and mechanical loads resulting from various combustion modes. The reactor safety concerns associated with this issues are discussed. These include (1) the probability and consequences of direct failure of containment from hydrogen deflagration, dynamic overpressurization due to accelerated flames or detonations, and breach of containment from penetration by combustion-generated missiles, (2) the survival and functioning of safety-related equipment exposed to hydrogen burns, and (3) the alteration of accident consequences by the changing state of fission products as a result of hydrogen combustion.

41041 (NUREG—1265, pp 7.1-7.19) **Iodine chemical form.** Chan, L.K. May 1987. NTIS, PC A09/MF A01 - GPO. File Number TI87900729.

In Uncertainty papers on severe accident source terms.

The low release of iodine from the Three Mile Island plant during the 1979 accident suggested to some that a possible explanation might be the formation of a low-volatility iodide compound, namely cesium iodide (CsI), and that it was transported as such within the plant instead of molecular iodine as previously assumed. Thermodynamic analyses conducted showed the formation of CsI during transport in the reactor coolant system (RCS) but its formation was not favored in the reactor core. However, the analyses considered only the effects of parameters known, at the time of the study, to affect the chemical form of iodine. Additional experimental evidence, although preliminary and in some cases not reproducible, indicates that other factors may also affect CsI stability in the RCS and containment. If CsI were stable and were extensively retained in the RCS, it would be susceptible to revaporization later in the accident. CsI revaporized from the RCS would enter the containment when mitigative processes are less potent. If the containment fails at this time, the net result of CsI stability is to create a late source of iodine. This issue, therefore, is what are the chemical forms of iodine in the RCS and containment, and what are their relative quantities over the range of severe accident conditions. These possibilities are discussed.

41042 (NUREG—1265, pp 8.1-8.16) **Fission product revaporization.** Chan, L.K. May 1987. NTIS, PC A09/MF A01 - GPO. File Number TI87900729.

In Uncertainty papers on severe accident source terms.

One of the major developmental advances in severe accident analysis since the Reactor Safety Study relates to the accounting for radionuclide retention in the reactor coolant system (RCS). The retention is predicted to occur as materials released during core heatup and degradation are transported through the RCS to the break (broken pipe, relief valve, etc.). For accidents involving relatively long RCS-transit times (e.g., station blackout in PWRs), the fraction of released material predicted to remain in the RCS can be large. For example, calculations for the Surry station blackout sequence showed retention of approximately 80% of the cesium and iodine species. Factors affecting fission product revaporization are post-vessel-failure thermal hydraulics, heat loss through vessel and pipe walls, and revaporization chemistry. The accident conditions relevant to this issue range from those present immediately after vessel failure to those present after containment failure. The factors that affect fission product revaporization are discussed.

41043 (NUREG/CR—2000-Vol.6-No.5) **Licensee event report (LER) compilation for month of May 1987.** (Oak Ridge National Lab., TN (USA). Nuclear Safety Information Center; Nuclear Regulatory Commission, Washington, DC (USA). Office for Analysis and Evaluation of Operational Data). Jun 1987. Contract AC05-84OR21400. 105p. (ORNL/NSIC—200-Vol.6-No.5). NTIS, PC A06/MF A01 - GPO. File Number TI87011842.

This monthly report contains Licensee Event Report (LER) operational information that was processed into the LER data file of the Nuclear Safety Information Center (NSIC) during the one month period identified on the cover of the document. The LERs, from which this information is derived, are submitted to the Nuclear Regulatory Commission (NRC) by nuclear power plant licensees in accordance with federal regulations. The LER summaries in this report are arranged alphabetically by facility name and then chronologically by event date for each facility. Component, system, keyword, and component vendor indexes follow the summaries. Vendors are those identified by the utility when the LER form is initiated; the keywords for the component, system, and general keyword indexes are assigned by the computer using correlation tables from the Sequence Coding and Search System.

41044 (NUREG/CR—4407) **Pipe break frequency estimation for Nuclear Power Plants.** Wright, R.E.; Steverson, J.A.; Zuroff, W.F. (EG and G Idaho, Inc., Idaho Falls (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor and Plant Systems). May 1987. Contract AC07-76ID01570. 110p. (EGG—2421). NTIS, PC E07/MF A01 - GPO. File Number TI87012379.

Contains 5 sheets of 24 + 48x reduction microfiche.

This study empirically develops frequencies of safety-significant pipe failures in commercial nuclear power plants (NPPs). Its primary purpose is to update the pipe break frequencies reported in the Reactor Safety Study, WASH-1400, which are used in many risk analyses. The study involved reviewing various data sources for actual piping failure events of significant magnitude. When extant in the documentation reviewed, information was extracted concerning conditional factors such as the system in which the failure occurred, operational mode of the plant, and size of the pipe involved to estimate conditional pipe break frequencies useful to risk analysts. Because of the high quality piping used in NPPs, there have been few significant pipe failures. An attempt was made to augment the analysis with synthetic data from a Delphi approach, but the wide uncertainty bounds on the resulting estimates rendered the results unsuitable for combining data.

41045 (NUREG/CR—4531) **An investigation of integral facility scaling and data relation methods (Integral System Test Program).** Larson, T.K. (EG and G Idaho, Inc., Idaho Falls (USA)). Feb 1987. Contract AC07-76ID01570. 127p. (EGG—2440). NTIS, PC A07/MF A01 - GPO. File Number TI87007047.

The Integral Systems Test (IST) Program was initiated in 1982 by government and industry to provide information needed to help resolve issues raised by the accident at the Three Mile Island nuclear power station. Three different integral test facilities, each scaled to a Babcock and Wilcox (B & W) design nuclear steam supply system, will ultimately contribute data to meet the objectives of the program. Each of the facilities was designed using different scaling methodologies, and each has different operating capabilities, such as maximum operating pressure and core power. The overall scaling of each facility is examined in this report, and local scaling is analyzed to demonstrate potential similarities and dissimilarities in facility response relative to expected plant responses. The scaling relationships are used to show how local thermal-hydraulic phenomena in each facility can be compared to each other or to expected plant behavior. The concept of an equilibrium plot is used to show how the global response of each facility can be related for a specific small break loss-of-coolant transient. Potential complications that may arise as a consequence of the facility scaling or facility limitations are enumerated. The potential use of dimensionless groupings for relating and specifying experiments is discussed. Finally, some specific experiments and conditions are proposed for the purpose of simplifying interfacility comparison of test results.

41046 (NUREG/CR—4550-Vol.6-Pt.1) **Analysis of core damage frequency from internal events, Grand Gulf, Unit 1: Main report.** Drouin, M.T.; LaChance, J.L.; Shapiro, B.J.; Harper, F.T.; Wheeler, T.A. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor Systems Safety; Sandia National Labs., Albuquerque, NM (USA)). Apr 1987. Contract AC04-76DP00789. 514p. (SAND—86-2084-Vol.6-Pt.1). NTIS, PC A22/MF A01 - GPO. File Number TI87011843.

This document contains the accident sequence analyses for Grand Gulf Unit 1, one of the reference plants being examined as part of the NUREG-1150 effort by the Nuclear Regulatory Commission. NUREG-1150 will document the risk of a selected group of nuclear power plants. As part of that work, this report contains the overall core damage frequency estimate for Grand Gulf Unit 1 and the accompanying plant damage state frequencies. Sensitivity

and uncertainty analyses provide additional insights regarding the dominant contributors to the Grand Gulf core damage frequency estimate. The mean core damage frequency at Grand Gulf was calculated to be 2.9E-5. Station blackout type accidents (i.e., loss of all ac power accidents) were found to dominate the overall results. Anticipated transient without scram accidents were also found to be contributors. The numerical results are largely driven by common mode failure probability estimates and, to some extent, human error. Because of significant data uncertainties in these two areas, it is recommended that the results of the uncertainty and sensitivity analyses be considered before any future actions are taken based on this analysis. In particular, the single most dominant scenario may require a more detailed data search and analysis before actions are implemented on the basis of the scenario.

41047 **(NUREG/CR—4550-Vol.6-Pt.2) Analysis of core damage frequency from internal events, Grand Gulf, Unit 1: Appendices.** Drouin, M.T.; LaChance, J.L.; Shapiro, B.J.; Harper, F.T.; Wheeler, T.A. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor Systems Safety; Sandia National Labs., Albuquerque, NM (USA)). Apr 1987. Contract AC04-76DP00789. 555p. (SAND—86-2084-Vol.6-Pt.2). NTIS, PC A24 - GPO. File Number DE87011844.

This document contains the accident sequence analyses for Grand Gulf Unit 1, one of the reference plants being examined as part of the NUREG-1150 effort by the Nuclear Regulatory Commission. NUREG-1150 will document the risk of a selected group of nuclear power plants. As part of that work, this report contains the overall core damage frequency estimate for Grand Gulf Unit 1 and the accompanying plant damage state frequencies. Sensitivity and uncertainty analyses provide additional insights regarding the dominant contributors to the Grand Gulf core damage frequency estimate. The mean core damage frequency at Grand Gulf was calculated to be 2.9E-5. Station blackout type accidents (loss of all AC power accidents) were found to dominate the overall results. Anticipated transient without scram accidents were also found to be contributors. The numerical results are largely driven by common mode failure probability estimates and, to some extent, human error. Because of significant data uncertainties in these two areas, it is recommended that the results of the uncertainty and sensitivity analyses be considered before any future actions are taken based on this analysis. In particular, the single most dominant scenario may require a more detailed data search and analysis before actions are implemented on the basis of this scenario.

41048 **(NUREG/CR—4710) Shutdown decay heat removal analysis of a Combustion Engineering 2-loop pressurized water reactor: Case study.** Cramond, W.R.; Ericson, D.M. Jr.; Sanders, G.A. (Sandia National Labs., Albuquerque, NM (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor and Plant Systems). Aug 1987. Contract AC04-76DP00789. 773p. (SAND—86-1797). NTIS, PC A99/MF A01 - GPO. File Number TI87013103.

This is one of six case studies for USI A-45 Decay Heat Removal (DHR) Requirements. The purpose of this study is to identify any potential vulnerabilities in the DHR systems of a typical Combustion Engineering 2-loop PWR, to suggest possible modifications to improve the DHR capability, and to assess the value and impact of the most promising alternatives to the existing DHR systems. The systems analysis considered small LOCAs and transient internal initiating events, and seismic, fire, extreme wind, internal and external flood, and lightning external events. A full-scale systems analysis was performed with detailed fault trees and event trees including support system dependencies. The system analysis results were extrapolated into release categories using applicable past PRA phenomenological results and improved containment failure mode probabilities. Public consequences were estimated using site specific CRAC2 calculations. The Value-Impact (VI) analysis of possible alternatives considered both onsite and offsite impacts arriving at several risk measures such as averted population dose out to a 50-mile radius and dollars per person rem averted. Uncertainties in the VI analysis are discussed and the issues of feed and bleed and secondary blowdown are analyzed.

41049 **(NUREG/CR—4768-Vol.1) Methodology and application of surrogate plant PRA analysis to the Rancho Seco Power Plant: Task 1, Analysis of ANO-1 and Oconee PRAs.** Gore, B.F. (Pacific Northwest Lab., Richland, WA (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor Safety and Projects). Jul 1987. Contract AC06-76RL01830. 72p. (PNL—6032-1). NTIS, PC A04/MF A01 - GPO. File Number TI87012739.

This two-volume report presents the development and first application of a methodology for using generic PRA information to identify risk-important systems and components at a plant lacking a PRA. The methodology requires the detailed analysis of both similarities and differences between related plants. It is applied in an analysis of the Rancho Seco plant using information from PRAs for the ANO-1 and Oconee plants. It is generic, drawing upon the functional and design similarities of B and W plants, yet it incorporates considerable plant specificity through the detailed comparative analysis of systems. Volume 1 presents the analysis of the surrogate plant PRAs. Dominant cut sets leading to core melt are identified and analyzed to determine the Fussel-Vesely Importance of plant systems. In Volume 2 the dominant cut sets are further analyzed to identify and categorize important system failure modes. The Rancho Seco plant is then studied to determine the plausibility and importance of similar failure modes for: High Pressure Injection, Low Pressure Injection, Emergency Feedwater, Service Water, Vital ac power and dc Power systems. Plant-specific information is then presented identifying Rancho Seco components, power supplies, and operating modes associated with the failure modes for the first four of these systems.

41050 **(NUREG/CR—4768-Vol.2) Methodology and application of surrogate plant PRA analysis to the Rancho Seco Power Plant: Final report.** Gore, B.F.; Huenefeld, J.C. (Pacific Northwest Lab., Richland, WA (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor Safety and Projects). Jul 1987. Contract AC06-76RL01830. 85p. (PNL—6032-2). NTIS, PC A05/MF A01 - GPO. File Number TI87012740.

This report presents the development and the first application of generic probabilistic risk assessment (PRA) information for identifying systems and components important to public risk at nuclear power plants lacking plant-specific PRAs. A methodology is presented for using the results of PRAs for similar (surrogate) plants, along with plant-specific information about the plant of interest and the surrogate plants, to infer important failure modes for systems of the plant of interest. This methodology, and the rationale on which it is based, is presented in the context of its application to the Rancho Seco plant. The Rancho Seco plant has been analyzed using PRA information from two surrogate plants. This analysis has been used to guide development of considerable plant-specific information about Rancho Seco systems and components important to minimizing public risk, which is also presented herein.

41051 **(NUREG/CR—4781) Study of severe accident mitigation systems.** Cherdack, R.; Hess, C.; Lee, K.; Miller, D. (Burns and Roe, Inc., Oradell, NJ (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor Systems Safety). May 1987. Contract AC04-76DP00789. 700p. (SAND—87-7064). NTIS, PC A99/MF A01 - GPO. File Number TI87011925.

This study has been performed as part of the Severe Accident Risk Reduction Program (SARRP) to investigate the feasibility and costs of installing various systems designed to mitigate the effects of severe accidents in light water reactors (LWRs). The primary function of the systems is to maintain the integrity of the reactor containment in the event of a severe accident - one in which susbstantial core melting and reactor vessel failure occur. The systems evaluated include (1) a hydrogen ignition system with capabilities for detecting hydrogen concentrations, initiating hydrogen burning, and avoiding the triggering of detonations; (2) a reactor cavity flooding system capable of introducing large quantities of water in the reactor cavity and adjacent regions; (3) a core debris management system that would prevent the core debris from a failed reactor vessel from interacting with significant quantities of water and with the concrete of the cavity; (4) an alternate contain-

ment spray system that would operate without relying on any existing plant electrical power supplies; and (5) a passive containment heat removal system that would remove heat from the containment atmosphere by condensing stream. These systems were considered for installation in three types of LWR containments. Conceptual designs and associated cost estimates were developed for two proposed combinations of these systems. This work provides an input to the cost-benefit analyses conducted in the SARRP Program in support of NRC's assessment of severe accident risks.

41052 **(NUREG/CR—4805/1) Reactor Safety Research: Semiannual report, January-June 1986: Reactor Safety Research Program.** (Sandia National Labs., Albuquerque, NM (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Accident Evaluation). May 1987. Contract AC04-76DP00789. 358p. (SAND—86-2752/1). NTIS, PC A16/MF A01 - GPO. File Number TI87012056.

Sandia National Laboratories is conducting, under USNRC sponsorship, phenomenological research related to the safety of commercial nuclear power reactors. The research includes experiments to simulate the phenomenology of accident conditions and the development of analytical models, verified by experiment, which can be used to predict reactor and safety systems performance behavior under abnormal conditions. The objective of this work is to provide NRC requisite data bases and analytical methods to (1) identify and define safety issues, (2) understand the progression of risk-significant accident sequences, and (3) conduct safety assessments. The collective NRC-sponsored effort at Sandia National Laboratories is directed at enhancing the technology base supporting licensing decisions.

41053 **(NUREG/CR—4817) Iodine partition coefficient measurements at simulated PWR steam generator conditions: Interim data report.** Clinton, S.D.; Simmons, C.M. (Oak Ridge National Lab., TN (USA); Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research). May 1987. Contract AC05-84OR21400. 26p. (ORNL/TM—10330). NTIS, PC A03/MF A01 - GPO. File Number TI87009813.

Iodine partition coefficients (defined as the ratio of the concentration of iodine species in the aqueous solution to the iodine concentration in the vapor phase) were measured at simulated PWR steam generator conditions (285°C and 6.9 MPa), using carrier-free radioactive ^{131}I in the form of sodium iodide. The iodine tracer concentration was maintained at $\sim 6 \times 10^{-11}$ mol/L; boric acid concentration was varied from 0 to 0.4 mol/L; and the solution pH (measured at 25°C) was adjusted from 4 to 9 by the addition of lithium hydroxide. Iodine partition coefficients decrease with increasing boric acid concentration; however, the iodine volatility is essentially independent of the solution pH for a given boric acid concentration. Sparging the solutions with air at room temperature increases the iodine volatility by an order of magnitude, compared to that achieved with argon sparging. Iodine partition coefficient measurements ranged from a low of 200 (in 0.2 M boric acid sparged with air) to 400,000 (in purified water sparged with argon).

41054 (NUREG/CR—4830, pp 1.1-1.11) **MELCOR 1.6 calculations for adiabatic expansion of hydrogen, two-cell flow.** Leigh, C.D.; Dingman, S.E. Mar 1987. NTIS, PC A10/MF A01 - GPO. File Number TI87010665. (SAND—86-2689).

In MELCOR validation and verification: 1986 papers.

MELCOR calculations for the adiabatic flow of hydrogen between two control volumes have been performed and compared to the closed form analytical solution. The MELCOR results differ only slightly from the analytical solution. The differences are caused by the use of a temperature dependent heat capacity in MELCOR, which introduces some deviation from the ideal gas assumptions.

41055 (NUREG/CR—4830, pp 2.1-2.4) **MELCOR 1.6 calculations for a saturated liquid depressurization test.** Shaffer, C.J. (Science and Engineering Associates, Albuquerque, NM). Mar 1987. NTIS, PC A10/MF A01 - GPO. File Number TI87010665. (SAND—86-2689).

In MELCOR validation and verification: 1986 papers.

A simple test involving a volume containing saturated water at high pressure depressurizing into a second larger volume tests MELCOR's ability to predict the depressurization of a reactor vessel into its containment. The results show good agreement between the MELCOR and analytical solutions.

41056 (NUREG/CR—4830, pp 3.1-3.11) **MELCOR 1.6 calculations for the HDR containment experiment V44.** Shaffer, C.J. (Science and Engineering Associates, Albuquerque, NM). Mar 1987. NTIS, PC A10/MF A01 - GPO. File Number TI87010665. (SAND—86-2689).

In MELCOR validation and verification: 1986 papers.

The MELCOR code has been used to simulate the HDR experiment V44. The HDR-V44 experiment is a reactor-scale steam blowdown experiment conducted in 1982 by Kernforschungszentrum Karlsruhe (KfK) at the decommissioned HDR reactor facility near Frankfurt, West Germany. The MELCOR predicted peak containment pressure is about 24% higher than measured but the longer term pressures are in good agreement. The MELCOR predicted main compartment temperature peaks about 20 K higher than measured with good long term agreement. Agreement between MELCOR predictions and the experimental results is similar to that obtained using the CONTAIN code.

41057 (NUREG/CR—4830, pp 4.1-4.8) **MELCOR 1.0 calculations for the Battelle-Frankfurt gas mixing tests.** Byers, R.K. Mar 1987. NTIS, PC A10/MF A01 - GPO. File Number TI87010665. (SAND—86-2689).

In MELCOR validation and verification: 1986 papers.

Recent comparisons of MELCOR predictions to the Battelle-Frankfurt Gas Mixing Experiments are presented. These predictions are for a hydrogen-nitrogen gas mixture that is injected into a model containment. The MELCOR results are compared to the experimental data, the results obtained using the HECTR code, and the results obtained using the RALOC code. This comparison provides critical testing of the MELCOR control volume hydrodynamics package and the flow path package.

41058 (NUREG/CR—4830, pp 5.1-5.8) **MELCOR 1.0 and HECTR 1.5 calculations for Browns Ferry reactor building burns.** Dingman, S.E.; Haskin, F.E. Mar 1987. NTIS, PC A10/MF A01 - GPO. File Number TI87010665. (SAND—86-2689).

In MELCOR validation and verification: 1986 papers.

Following drywell failure in postulated severe accidents at Browns Ferry, hydrogen burns could occur in the reactor building. MELCOR and HECTR calculations for such burns have been performed. When using the same flame speed, the two codes predict similar pressure responses. However, the magnitude of the pressure rises differs somewhat because the preburn conditions are slightly different. These differences are due to different treatments of the control volume gravity head and heat transfer/condensation in the two codes. Some MELCOR improvements are suggested.

41059 (NUREG/CR—4830, pp 6.1-6.4) **MELCOR 1.0 calculations for cooling of structures in a fluid.** Demmie, P.N. Mar 1987. NTIS, PC A10/MF A01 - GPO. File Number TI87010665. (SAND—86-2689).

In MELCOR validation and verification: 1986 papers.

MELCOR calculations were performed for the cooling of two uniform structures (rectangular and cylindrical) with constant thermal properties and heat transfer coefficients. The temperatures as a function of time for the structures are compared in this paper to the exact analytical solution and to SCDAP results. The good agreement between the MELCOR results, the SCDAP results, and the exact analytical solution show that the finite- difference methods used in the MELCOR Heat Structure Package produce accurate results.

41060 (NUREG/CR—4830, pp 7.1-7.5) **MELCOR 1.0 calculations for radial conduction in annular structures.** Dingman, S.E. Mar 1987. NTIS, PC A10/MF A01 - GPO. File Number TI87010665. (SAND—86-2689).

In MELCOR validation and verification: 1986 papers.

MELCOR predictions of the steady state temperature distributions resulting from radial heat conduction in annular structures

have been compared to the exact analytical solutions for two sets of boundary conditions and two cylinder sizes. The agreement between MELCOR results and the analytical solution is excellent in all cases.

41061 (NUREG/CR—4830, pp 8.1-8.16) **MELCOR 1.1 calculations for a semi-infinite solid heat structure test.** Shaffer, C.J. (Science and Engineering Associates, Albuquerque, NM). Mar 1987. NTIS, PC A10/MF A01 - GPO. File Number TI87010665. (SAND—86-2689).

In MELCOR validation and verification: 1986 papers.

Predictions of the MELCOR heat structure package have been compared to the exact analytical solution for transient heat flow in a semi-infinite solid with convective boundary conditions. Comparisons have been made for steel and concrete, various thermal conductivities, atmospheric temperatures, node structures and time steps. MELCOR results appear to be more accurate for cases involving materials with low thermal conductivities like concrete rather than high thermal conductivities like steel, although in either case the accuracy of the MELCOR results is quite good (.3% error in the integrated heat flux for concrete and .6% error in the integrated heat flux for steel). Guidelines regarding node spacings in typical concrete containment walls have been developed.

41062 (NUREG/CR—4830, pp 9.1-9.14) **MELCOR 1.5 calculations for ABCOVE Aerosol experiments AB5, AB6, and AB7.** Leigh, C.D. Mar 1987. NTIS, PC A10/MF A01 - GPO. File Number TI87010665. (SAND—86-2689).

In MELCOR validation and verification: 1986 papers.

The MELCOR code was used to simulate the ABCOVE Aerosol experiments AB5, AB6, and AB7. In these tests, a dry sodium aerosol was introduced into an 850 m^3 vessel and the aerosol behavior was monitored. Single and double component aerosols were used. Other codes have been used to simulate these tests including the CONTAIN code at Sandia National Laboratories. Results from MELCOR were compared both to the experimental data and to the CONTAIN results. MELCOR results were nearly identical to the CONTAIN results. Code predictions for the suspended mass of aerosol track the experimental data to the end of the experiment to within a factor of two or three. Final predictions of the mass deposited by settling agree within an 11% error for all tests. In AB5, code predictions for the mass of material deposited by plating agree with the experimental data with a 12% error. However, in the other tests, the codes do not give accurate results for the amount of material deposited on the walls at the end of the test. These errors are probably related to the turbulence in the vessel which may cause inertial impaction. Impaction is not modeled in either of the codes.

41063 **(NUREG/CR—4859) Seismic fragility test of a 6-inch diameter pipe system.** Chen, W.P.; Onesto, A.T.; DeVita, V. (Rockwell International Corp., Canoga Park, CA (USA). Energy Technology Engineering Center; Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering Safety). Feb 1987. 172p. NTIS, PC A08/MF A01 - GPO. File Number TI87900555.

This report contains the test results and assessments of seismic fragility tests performed on a 6-inch diameter piping system. The test was funded by the US Nuclear Regulatory Commission (NRC) and conducted by ETEC. The objective of the test was to investigate the ability of a representative nuclear piping system to withstand high level dynamic seismic and other loadings. Levels of loadings achieved during seismic testing were 20 to 30 times larger than normal elastic design evaluations to ASME Level D limits would permit. Based on failure data obtained during seismic and other dynamic testing, it was concluded that nuclear piping systems are inherently able to withstand much larger dynamic seismic loadings than permitted by current design practice criteria or predicted by the probabilistic risk assessment (PRA) methods and several proposed nonlinear methods of failure analysis.

41064 **(NUREG/CR—4886) Analysis of the NESDIP2 and NESDIP3 radial shield and cavity experiments.** Maerker, R.E. (Oak Ridge National Lab., TN (USA); Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research). May 1987. Contract AC05-84OR21400. 56p. (ORNL/TM—10389). NTIS, PC A04/MF A01 - GPO. File Number TI87009582.

Discrete ordinates calculations were made of a series of measurements performed using the NESTOR reactor at AEE Winfrith. These measurements are part of the NESDIP experimental program designed to benchmark methods and data commonly used in interpreting pressure vessel surveillance dosimetry placed at either in-vessel or ex-vessel locations. Results obtained using the LEPRICON procedures and updated ELXSIR cross sections indicate agreement to within about 10% with measured threshold dosimeter activities behind various components of a radial shield containing up to 25 cm of water and 24 cm of steel. Significant discrepancies in the energy range between 0.1 and 2 MeV were found to exist with measurements made on the centerline of a 29-cm-wide cavity and at vertical locations considerably above the centerline of a 21-cm-wide cavity, however. A logical explanation of the latter discrepancy is the failure of two independent two-dimensional calculations to properly treat the three-dimensional effects of vertical cavity streaming. No satisfactory explanation has yet surfaced for the first discrepancy, however, which is the more important of the two in possible affecting the interpretation of ex-vessel, low threshold (~100 KeV) dosimetry.

41065 **(NUREG/CR—4887) POSTCON: A postprocessor and unit conversion program for the contain computer code.** Washington, K.E. (Sandia National Labs., Albuquerque, NM (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor Systems Safety). May 1987. Contract AC04-76DP00789. 63p. (SAND—87-0562). NTIS, PC A04/MF A01 - GPO. File Number TI87012684.

The numerical predictions from use of the CONTAIN severe reactor accident containment analysis computer code normally take the form of massive quantities of output data. The purpose of the POSTCON computer program is to provide an easy-to-use and efficient method for examining such results. In this report the capabilities of POSTCON are described and instructions for the use of the program are given. In order to clarify the discussion of the input options and output format, several examples are presented including actual input, output, and vector files. The summary sections of this document serve as a user's manual and can be consulted for the construction of simple POSTCON input files. The detailed sections and Appendix A serve as a comprehensive reference manual that can be consulted for advanced POSTCON applications. The overall capabilities of POSTCON include extraction of all transient data from CONTAIN binary plot files, multiple file handling, a flexible unit conversion system, snapshot and histogram options, automatic pagination and labeling of tables, and vector output files for plot program interfacing.

41066 **(NUREG/CR—4891) Properties of reactor fuel rod materials at high temperatures: Final summary report: Severe Core Damage Property Tests Program.** Prater, J.T.; Courtright, E.L. (Pacific Northwest Lab., Richland, WA (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor Accident Analysis). Jul 1987. Contract AC06-76RL01830. 43p. (PNL—6164). NTIS, PC A03/MF A01 - GPO. File Number TI87013281.

This report summarizes work sponsored by the US Nuclear Regulatory Commission Division of Accident Evaluation to investigate those physical properties that are needed to predict the behavior of fuel-rod assemblies during a loss-of-coolant accident. The results include a determination of the oxidation kinetics of Zircaloy and Zircaloy-uranium oxide mixtures in steam and steam-hydrogen gas mixtures at 1300 to 2400°C, viscosity measurements of zirconium-oxide mixtures at 1800 to 2100°C, an estimate of the heat of reaction for the dissolution of uranium oxide by molten zirconium at 2000°C, and thermal diffusivity measurements on prereacted Zircaloy-uranium oxide mixtures at 800 to 1500°C.

41067 **(NUREG/CR—4896) Containment loads due to direct containment heating and associated hydrogen behavior: Analysis and calculations with the CONTAIN code.** Williams, D.C.; Bergeron, K.D.; Carroll, D.E.; Gasser, R.D.; Tills, J.L.; Washington, K.E. (Sandia National Labs., Albuquerque, NM (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor Systems Safety). May 1987. Contract AC04-76DP00789. 162p. (SAND—87-0633). NTIS, PC A08/MF A01 - GPO. File Number TI87012896.

One of the most important unresolved issues governing risk in many nuclear power plants involves the phenomenon called direct containment heating (DCH), in which it is postulated that molten corium ejected under high pressure from the reactor vessel is dispersed into the containment atmosphere, thereby causing sufficient heating and pressurization to threaten containment integrity. Models for the calculation of potential DCH loads have been developed and incorporated into the CONTAIN code for severe accident analysis. Using CONTAIN, DCH scenarios in PWR plants having three different representative containment types have been analyzed: Surry (subatmospheric large dry containment), Sequoyah (ice condenser containment), and Bellefonte (atmospheric large dry containment). A large number of parameter variation and phenomenological uncertainty studies were performed. Response of DCH loads to these variations was found to be quite complex; often the results differ substantially from what has been previously assumed concerning DCH. Containment compartmentalization offers the potential of greatly mitigating DCH loads relative to what might be calculated using single-cell representations of containments, but the actual degree of mitigation to be expected is sensitive to many uncertainties. Dominant uncertainties include hydrogen combustion phenomena in the extreme environments produced by DCH scenarios, and factors which affect the rate of transport of DCH energy to the upper containment. In addition, DCH loads can be aggravated by rapid blowdown of the primary system, co-dispersal of moderate quantities of water with the debris, and quenching of de-entrained debris in water; these factors act by increasing steam flows which, in turn, accelerates energy transport. It may be noted that containment-threatening loads were calculated for a substantial portion of the scenarios treated for some of the plants considered.

41068 **(NUREG/CR—4905) Detonability of H_2-air-diluent mixtures.** Tieszen, S.R.; Sherman, M.P.; Benedick, W.B.; Berman, M. (Sandia National Labs., Albuquerque, NM (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor Systems Safety). Jun 1987. Contract AC04-76DP00789. 214p. (SAND—85-1263). NTIS, PC A10/MF A01 - GPO. File Number DE87012179.

This report describes the Heated Detonation Tube (HDT). Detonation cell width and velocity results are presented for H_2-air mixtures, undiluted and diluted with CO_2 and H_2O for a range of H_2 concentration, initial temperature and pressure. The results show that the addition of either CO_2 or H_2O significantly increases the detonation cell width and hence reduces the detonability of the mixture. The results also show that the detonation cell width is reduced (detonability is increased) for increased initial temperature and/or pressure.

41069 **(NUREG/CR—4925) Fission product behavior during the PBF [Power Burst Facility] Severe Fuel Damage Test 1-1.** Hartwell, J.K.; Petti, D.A.; Hagrman, D.L.; Jensen, S.M.; Cronenberg, A.W. (EG and G Idaho, Inc., Idaho Falls (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Accident Evaluation). May 1987. Contract AC07-76ID01570. 162p. (EGG—2462). NTIS, PC E10/MF A01 - GPO. File Number TI87011023.

In response to the accident at Three Mile Island Unit 2 (TMI-2), the United States Nuclear Regulatory Commission (USNRC) initiated a series of Severe Fuel Damage tests that were performed in the Power Burst Facility at the Idaho National Engineering Laboratory to obtain data necessary to understand (a) fission product release, transport, and deposition; (b) hydrogen generation; and (c) fuel/cladding material behavior during degraded core accidents. Data are presented about fission product behavior noted during the second experiment of this series, the Severe Fuel Damage Test 1-1, with an in-depth analysis of the fission product release, transport, and deposition phenomena that were observed. Real-time release and transport data of certain fission products were obtained from on-line gamma spectroscopy measurements. Liquid and gas effluent grab samples were collected at selected periods during the test transient. Additional information was obtained from steamline deposition analysis. From these and other data, fission product release rates and total release fractions are estimated and compared with predicted release behavior using current models. Fission product distributions and a mass balance are also summarized, and certain probable chemical forms are predicted for iodine, cesium, and tellurium. An in-depth evaluation of phenomena affecting the behavior of the high-volatility fission products - xenon, krypton, iodine, cesium, and tellurium - is presented. Analysis indicates that volatile release from fuel is strongly influenced by parameters other than fuel temperature. Fission product behavior during transport through the Power Burst Facility effluent line to the fission product monitoring system is assessed. Tellurium release behavior is also examined relatve to the extent of Zircaloy cladding oxidation. 81 fig., 53 tabs.

41070 **(ORNL—4169/V2/S3) The Oak Ridge Research Reactor: Safety analysis: Volume 2, Supplement 3.** Cook, D.H.; Hamrick, T.P. (comps.). (Oak Ridge National Lab., TN (USA)). 29 Jun 1987. Contract AC05-84OR21400. 13p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87011966.

The Oak Ridge Research Reactor (ORR) was constructed in the mid 1950s. Since it is an older facility, the issue of life-limiting conditions or material deterioration resulting from prolonged exposure to the normal operating environment is an item that should be addressed in the safety analysis for the ORR. Life-limiting conditions were considered in the original design of ORR; but due to the limited data that were available at that time on material performance in research reactors, various studies were completed during the first 10 years of operation at ORR to verify the applicable life-limiting parameters. Based on today's knowledge of life limiting conditions and the previous 30 years of operating experience at the ORR facility, the three specific areas of concern are addressed in this supplement: (1) embrittlement of the structures due to radiation damage, which is described in Section 2; (2) fatigue due to the effects of both thermal cycling and vibration, which is addressed in Section 3; and (3) the effects of corrosion on the integrity of the primary system, which is described in Section 4. The purpose of this document is to provide a review of the applicable safety studies which have been performed, and to state the status of the ORR with regard to embrittlement, fatigue (due to thermal cycling and vibration), and corrosion.

41071 **(SAND—86-0867C) Experiments related to the resuspension of aerosols during hydrogen burns.** Nelson, L.S.; Guay, K.P. (Sandia National Labs., Albuquerque, NM (USA)). Jan 1987. Contract AC04-76DP00789. 21p. (CONF-870816—7). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87005882.

From 24. national heat transfer conference and exhibition; Pittsburgh, PA, USA (9 Aug 1987).

We have performed seven "add-on" experiments in two large combustion facilities to investigate the capability of hydrogen burns to remove simulated structural and fission product aerosols previously deposited on small metal discs that have surfaces prototypical of those found in nuclear reactor containments. Our results suggest that hydrogen combustion provides an especially effective mechanism for removal (and, presumably, resuspension) of sedimented aerosols produced in a hypothetical nuclear reactor core-degradation or core-melting accident. The presence of condensing steam does not seem to assure adhesion of sedimented aerosols during hydrogen burns. Differences are exhibited between different surfaces as well as between types of aerosol. In-depth studies will be required to assess the impact exposure of sedimented aerosols to hydrogen burns might have on the radiological source term.

41072 **(SAND—86-1605C) Design and construction of a large reinforced concrete containment model to be tested to failure.** Ucciferro, J.J.; Horschel, D.S. (Sandia National Labs., Albuquerque, NM (USA); United Engineers and Constructors, Inc., Philadelphia, PA (USA)). 1987. Contract AC04-76DP00789. 7p. (CONF-870812—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87005874.

From 9. SMIRT: international conference on structural mechanics in reactor technology; Lausanne, Switzerland (17 Aug 1987).

The US Nuclear Regulatory Commission is investigating the performance of LWR containments subjected to severe accidents. This work is being performed by the Containment Integrity Division at Sandia National Laboratories (Sandia). The latest research effort involves the testing of a 1/6-scale reinforced concrete containment model. The containment, which was designed and constructed by United Engineers and Constructors, is the largest and most complex model of its kind. The design and construction of the containment model are the subject of this paper. The objective of the containment model tests is to generate data that can be used to qualify methods for reliably predicting the response of LWR containment buildings to severe accident loads. The data recorded during testing include deformations and leakage past sealing surfaces, as well as strains and displacements of the containment shell.

41073 **(SAND—86-1656C) An evaluation of the leakage potential of a personnel airlock subject to severe accident loads.** Clauss, D.B. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 6p. (CONF-870812—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006125.

From 9. SMIRT: international conference on structural mechanics in reactor technology; Lausanne, Switzerland (17 Aug 1987).

A systematic investigation of the performance of light water reactor containment buildings subject to severe accident loads must include the consideration of leakage between the sealing surfaces of penetrations. As part of its work on containment integrity for the US Nuclear Regulatory Commission (USNRC), Sandia National Laboratories is developing test validated methods for predicting leakage from mechanical penetrations. The primary emphasis has been on large diameter operable penetrations, such as equipment hatches, personnel airlocks, and drywell heads. Several studies conducted for the USNRC have identified leakage from personnel airlocks as a potentially significant failure mode of containment buildings subject to severe accident loads, including Barnes et al. (1984) and Shackelford et al. (1985). Barnes et al (1984) conducted finite element analyses to predict separation of the sealing surfaces on the door and bulkhead, but they did not consider elevated temperature effects and they did not take credit for the performance of the seal material in calculating leak areas. To the author's knowledge, personnel airlock designs with flat bulkhead/door assemblies and seals have never been tested under severe accident conditions, i.e., elevated temperatures and pressure. This paper will describe preliminary analyses and plans for testing a full-size personnel airlock.

41074 **(SAND—86-2508C) Natural convection and in-cavity oxidation of combustible gases.** Wong, C. Channy. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1987. Contract AC04-76DP00789. 23p. (CONF-870816—13). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87007847.

From 24. national heat transfer conference and exhibition; Pittsburgh, PA, USA (9 Aug 1987).

The question of complete in-cavity oxidation of combustible gases produced by core-concrete interactions following vessel breach has been investigated. It is overly optimistic to assume a complete oxidation because a variety of phenomena, such as steam inerting and oxygen transport by natural convection, may influence the degree of in-cavity oxidation that takes place. HECTR analyses of an ice-condenser containment during an S2HF drain-closed accident show that the in-cavity oxidation process is limited by the rate at which oxygen is transported into the reactor cavity region. Accumulation and subsequent combustion of hydrogen and carbon monoxide in the upper and lower compartments generate a peak pressure of 384 kPa (56 psig) at 7.4 hours, that an earlier IDCOR analysis did not predict.

41075 **(SAND—86-2630) Parametric HECTR calculations of hydrogen transport and combustion at N Reactor.** Payne, A.C. Jr.; Camp, A.L. (Sandia National Labs., Albuquerque, NM (USA)). Jun 1987. Contract AC04-76DP00789. 444p. NTIS, PC A19/MF A01; 1; GPO Dep. File Number DE87013197.

This report describes a limited number of parametric calculations of hydrogen transport and combustion in the N Reactor confinement for selected accident sequences. The calculations are performed using the HECTR computer code, which is a lumped-parameter code developed specifically for evaluating hydrogen behavior in reactor containments. A number of parameters are evaluated in this study, including hydrogen source rate, spray effects, and source location. The calculations indicate that mixing within major compartments tends to occur fairly rapidly, but that mixing between compartments can be inhibited in certain situations, resulting in the formation of flammable mixtures. These results are being compared to calculations performed with other computer codes, including a code that uses finite-difference models. United Nuclear Corporation will present the results of these code comparisons in future reports.

41076 **(SAND—86-2838C) NUREG-1150 risk assessment methodology and results.** Benjamin, A.S.; Boyd, G.J.; Lewis, S.R.; Amos, C.N.; Cunningham, M.A.; Murphy, J.A. (Sandia National Labs., Albuquerque, NM (USA); Safety and Reliability Optimization Services, Knoxville, TN (USA); Technadyne Engineering Consultants, Inc., Albuquerque, NM (USA); Nuclear Regulatory Commission, Washington, DC (USA)). 1987. Contract AC04-76DP00789. 17p. (CONF-870820—6). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012980.

From PSA 87: international topical meeting on probabilistic safety assessment and risk management; Zurich, Switzerland (31 Aug 1987).

NUREG-1150 constitutes a full-scope reassessment of the risks to the public from several light water reactor plants with various containment types. Emphasis has been placed on determining the magnitude and character of the uncertainties, rather than focusing upon a point estimate. The risk-reduction potential of proposed plant modifications (backfits and procedural changes) has also been studied, and their costs and benefits have been evaluated. It has been found that the risks from internal events are generally lower than previously evaluated in the Reactor Safety Study (RSS). However, certain unresolved phenomenological issues cause the tops of the uncertainty bands to appear at levels that are comparable to or higher than the RSS point estimates. The issues that are important vary from plant to plant. Most of the postulated plant modifications do not appear to be cost-effective, although a few procedural changes are possible exceptions. Several reviews of this work are in progress, and a second iteration is being performed to include external events, incorporate new technical information, and address comments.

41077 **(UCRL—93501-Rev.1) Nuclear safety as applied to space power reactor systems.** Cummings, G.E. (Lawrence Livermore National Lab., CA (USA)). Jan 1987. Contract W-7405-ENG-48. 15p. (CONF-870102—22-Rev.1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009740.

From 4. symposium on space nuclear power systems; Albuquerque, NM, USA (12 Jan 1987).

Current space nuclear power reactor safety issues are discussed with respect to the unique characteristics of these reactors. An approach to achieving adequate safety and a perception of safety is outlined. This approach calls for a carefully conceived safety program which makes uses of lessons learned from previous terrestrial power reactor development programs. This approach includes use of risk analyses, passive safety design features, and analyses/experiments to understand and control off-design conditions. The point is made that some recent accidents concerning terrestrial power reactors do not imply that space power reactors cannot be operated safety.

41078 (UCRL—96072) Seismic margin reviews of nuclear power plants: Identification of important functions and systems. Prassinos, P.G.; Moore, D.L.; Amico, P.J. (Lawrence Livermore National Lab., CA (USA); Energy International, Inc., Kent, WA (USA); Applied Risk Technology Corp., Columbia, MD (USA)). 10 Feb 1987. Contract W-7405-ENG-48. 7p. (CONF-870812—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87005838.

From 9. SMIRT: international conference on structural mechanics in reactor technology; Lausanne, Switzerland (17 Aug 1987).

The purpose of this paper is to present the basis and method used for the development of the systems screening portion of the seismic margin review methodology. The results from the review of seven utility-sponsored seismic PRA's and one Seismic Safety Margins Research Program Study have been used to develop some insights regarding the importance of various systems and functions to seismic margins. (JDH)

41079 NRC regulation of TVA. Hearings before the Subcommittee on Oversight and Investigations of the Committee on Energy and Commerce, House of Representatives, Ninety-Ninth Congress, Second Session, February 26, June 11, and October 1, 1986. Washington, DC; Government Printing Office (1987). 442p.

Nuclear Regulatory Commissioners, Tennessee Valley Authority (TVA) chairman Charles Dean, and members of both agencies, as well as representatives of review groups testified at a hearing on the performance of regulators in overseeing TVA's nuclear programs, all of which are inoperative. The witnesses reviewed certification, licensing, and inspection processes which reflect poor management on the part of NRC and indifference to TVA. Of major concern was the sacrifice of safety for expeditious construction. The hearing took place over three days in February, June, and October of 1986. Material submitted for the record follows the testimony of the 19 witnesses.

41080 Hanford Nuclear Reactor: safety issues. Hearing before the Subcommittee on Energy and Power of the Committee on Energy and Commerce, House of Representatives, One Hundredth Congress, First Session, February 10, 1987. Washington, DC; Government Printing Office (1987). 129p.

Eight witnesses from DOE, the physics and engineering communities, the US Navy, and members of Congress testified at a hearing on safety issues involving the N-reactor, which was shut down for a safety reviews following the Chernobyl accident. The witnesses examined DOE procedures for the six-month shutdown in an effort to evaluate the risks to public health and safety from defense production facilities. At issue was DOE's efforts to keep the reactor functioning at all costs and the possible conflict of interest in having DOE provide its own oversight when DOE facilities do not meet the environmental and safety standards required of commercial operations. Also at issue was whether the N-Reactor is truly essential to national security. Additional material submitted by DOE for the record follows the testimony.

25 ENERGY STORAGE

2501 Magnetic

41081 (AD-A—180182/8/XAB) High voltage, high-power operation of the plasma-erosion opening switch. Interim report. Neri, J.M.; Boller, J.R.; Ottinger, P.F.; Weber, B.V.; Young, F.C. (JAYCOR, Vienna, VA (USA)). 7 Apr 1987. 10p. NTIS, PC A02/MF A01.

A Plasma Erosion Opening Switch (PEOS) is used as the opening switch for a vacuum inductive storage system driven by a 1.8-MV, 1.6-TW pulsed power generator. A 135-nH vacuum inductor is current charged to about 750 kA in 50 ns through the closed PEOS which then opens in < 10 ns into an inverse ion diode load. Electrical diagnostics and nuclear activations from ions accelerated in the diode yield a peak load voltage (4.25 MV) and peak load power (2.8 TW) that are 2.4 and 1.8 times greater than ideal matched-load values for the same generator pulse.

2502 Compressed Gas

41082 (EPRI-AP—5301) Proceedings: Geotechnology workshop on compressed-air energy storage in porous media sites. (ANR Storage Co., Detroit, MI (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jul 1987. 373p. (CONF-8609314—). Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920526.

From Geotechnology workshop on compressed-air energy storage in porous media sites; Traverse City, MI, USA (23 Sep 1986).

The extensive experience of the natural gas industry with gas storage in underground porous media is directly applicable to the storage of air for compressed-air energy storage plants. In this workshop, natural gas industry representatives provided utility personnel with a basic understanding of the geology of porous media and strategies for developing air storage reservoirs.

2506 Thermal

REFER ALSO TO CITATION(S) 40730, 41149

2509 Batteries

REFER ALSO TO CITATION(S) 40771, 41397

41083 (BMFT-FB-T—86-168) Test of lead-acid accumulators for load-frequency control operation. Final report. Kraemer, K.G.; Dominik, H.; Voigt, B. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Berliner Kraft- und Licht (BEWAG)-A.G. (Germany, F.R.); EAB Energie-Anlagen Berlin G.m.b.H. (Germany, F.R.)). Dec 1986. 138p. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE87770216.

The results of this project prove the feasibility of battery energy storage units for load-frequency control and instantaneous reserve operation. A mode of operation has been defined which copes with both the requirements of the battery technology and the needs of the power plant dispatcher in the BEWAG insular network. Under this mode of operation, the battery service life is anticipated to exceed 8 years. Basing on the tests carried out in the test facility operational tests have been defined featuring battery state information under normal operational conditions. Problems regarding possible supply network disturbances due to the harmonics or reactive power consumption of the power conditioner could be solved; conditions for full-scale plant operation have been deduced. In order to demonstrate the advantages of battery energy storage in respect with both energy conservation and environmental protection, a +/- 8,5-MW-demonstration plant is now under construction at BEWAG's Steglitz power plant. It will be operating by November 1986. With 49 refs., 3 tabs., 55 figs.

41084 (EUR—10693-DE) Development of a version of the Ni/Cd accumulator that will be economical and as environmentally safe as possible by means of largely substituting Fe for the Cd and Ni for electrotraction purposes and for alternative energy storage. Final report. Kraemer, G.; Koehler, U. (Commission of the European Communities, Luxembourg. Directorate General Information Market and Innovation; Varta Batterie A.G., Kelkheim (Germany, F.R.). Forschungs- und Entwicklungszentrum). 1986. 80p. (In German). Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities.

Energie.

The development of an economical and environmentally harmless version of the nickel-cadmium accumulator made the setting of priorities necessary. In so doing, the shift of focus in the fields of use towards those for the gas-tight button cell had to be taken into account. Highest priority was given to the elimination of environmental hazards resulting from the industrial preparation of the active masses and the working of these into pressed electrodes. With the dry granulation method developed thus, a granulate is ob-

tained which can not only be processed without dust, hence without causing a health hazard to the people working with it, but also makes possible rapid and even tablet dosage by automated machines as a result of its good inherent flow properties thus leading to better usage of machine capacity, savings of materials and the reduction of reject losses at later stages of manufacture and hence greater economic efficiency. This is further increased by raising the electrical characteristic data in the accumulators manufactured using such granulate masses.

41085 **Design of thin-gap channel flow cells.** Edwards, V.; Newman, J. (AT and T Bell Labs., Murray Hill, NJ). *Journal of the Electrochemical Society;* **135**: No. 5, 1181-1186(May 1987).

A model for predicting the current, concentration, and potential distributions in a thin-gap channel flow is presented. The model does not invoke the thin diffusion layer assumption or the assumption of straight current lines, and it allows for multiple reactions. The model, however, does not include the effect of migration; thus, it is only valid for systems with excess supporting electrolyte. This model can be used for the design and scale-up of channel flow electrochemical reactors. Results are presented for a single reaction to show the effects of interacting diffusion boundary layers and of the axial component of current.

41086 **Oxygen activity and asymmetric polarization at the sodium/beta"-alumina interface.** Mailhe, C.; Visco, S.; De Jonghe, L. (Lawrence Berkeley Lab., Materials and Molecular Research, Univ. of California, Berkeley, CA). *Journal of the Electrochemical Society;* **135**: No. 5, 1121-1127(May 1987). Contract AC03-76SF00098.

Asymmetric polarization at the sodium/beta"-alumina interface during ionic charge transfer has been studied using cyclic voltammetry with Na/beta"-alumina/Na cells. It was found that contamination of the sodium electrode by oxygen, as O/sub 2/ or H/sub 2/O, causes asymmetric polarization. Polarization is quite severe in the range of 150°-200°C, and is attributed to the presence of an adsorbed oxide film. The adsorption/desorption behavior of the resistive film could be described by a simple Langmuir model. Asymmetric polarization can be eliminated by lowering the oxide content of the sodium electrode to levels such that adsorption is negligible. This is achieved by the use of carefully dried electrolyte tubes with either electrolytically generated sodium, or sodium from which the oxygen has been scavenged with Ti sponge.

41087 (SAND—86-1514-Vol.11-No.-1, pp 38-45) **Problem of energy storage: exploratory battery technology.** Apr 1987. NTIS, PC A04/MF A01. File Number DE87009977.

In Sandia technology: Volume 11, No. 1.

Government concern over US dependence on foreign and other unpredictable or exhaustible energy sources has led to the Department of Energy to underwrite an effort by industry and federal laboratories to develop efficient energy-storage devices. The goal is to develop new battery technologies in cooperation with industry. Specifically, the objectives are to develop and test electrochemical energy-storage systems that have high performance, low cost, long life, and high reliability for applications in electric vehicles, utility load-leveling, remotely located energy storage, and solar-energy storage systems. The approach in developing these batteries is to place contracts with industrial battery developers and to guide their work and evaluate their prototype units in laboratories.

29 ENERGY PLANNING AND POLICY

41088 **(NP—7770180) Energy economy position in Czechoslovakia.** Koehler, U. (comp.). (Johann-Gottfried-Herder-Institut, Marburg (Germany, F.R.)). Dec 1985. 164p. (In German). NTIS (US Sales Only), PC A08.

This document is intended to introduce the most important problems of the Czechoslovakian energy economy from press reports in Czechoslovakia. The originally intended time limitation to the consequences of the oil crises did not prove to be very useful. Not only did these events only act on the Czechoslovakian economy after a considerable delay, but the documentation will also make it clear that from the Czechoslovakian point of view, the increasing discrepancies of the energy balance were mostly caused by the internal energy economy. The brown and hard coal mined in Czechoslovakia is still the most important primary energy source. The texts selected for this volume cannot reproduce the multiplicity of problems, they should only give a survey of how the energy problems are published to the population of the country. For this reason, press material originating from Czechoslovakia was almost exclusively used. According to the guidelines for this documentation, in selecting the texts, the daily papers and journals were used. Scientific and technical literature is not used in this volume.

2901 Energy Analysis And Modeling

REFER ALSO TO CITATION(S) 41111, 41112, 41157, 41158, 41160, 41162, 41165, 41170, 41171, 41172, 41173, 41175, 41176, 41177, 41178, 41179, 41180, 41181, 41182, 41184, 41190, 41191, 41207, 41255, 41256, 41257, 41258

41089 **(CONF-8312151—Summs.) Strategies of energy supply for Third World countries.** (Technische Univ. Berlin (Germany, F.R.). Zentrum fuer Technologische Zusammenarbeit). Jun 1984. 110p. (In German). NTIS (US Sales Only), PC A06. File Number DE87770181.

From Seminar on strategies of energy supply for third world countries; Berlin, F.R. Germany (5 Dec 1983).

The 9 lectures and the discussions of the seminar are summarized. After a survey of world energy problems and a lecture on the effects of the choice of energy techniques on different energy developments, the other lectures deal with the energy planning and energy supply possibilities of developing countries.

41090 **(ORAU/IEA—25(1986)) Oak Ridge Associated Universities Institute for Energy Analysis research report 1986.** (Oak Ridge Associated Universities, Inc., TN (USA)). Apr 1987. Contract AC05-76OR00033. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013669.

Since its establishment as an ORAU division in 1974, the Institute for Energy Analysis has operated as a think tank on energy issues. Its primary accomplishments have been in making the carbon dioxide problem a politically recognized issue and in contributing to the survival of nuclear power, issues discussed in books authored by IEA staff. In FY86, IEA continued to emphasize these and other long-term projects, while branching out into the areas of nuclear waste and renewable energy applications.

2902 Economics And Sociology

REFER ALSO TO CITATION(S) 40501, 40720, 40721, 40899, 41155, 41156, 41157, 41158, 41159, 41163, 41165, 41166, 41168, 41169, 41170, 41171, 41172, 41173, 41174, 41175, 41184, 41186, 41188, 41190, 41191, 41194, 41200, 41207, 41210, 41211, 41215, 41218, 41219, 41220, 42271

41091 **(ORNL—6230) Studies of postdisaster economic recovery: Analysis, synthesis, and assessment.** Hill, L.J. (Oak Ridge National Lab., TN (USA)). Jun 1987. Contract AC05-84OR21400. 259p. NTIS, PC A12/MF A01. File Number DE87013357.

The US economy has been divided into two broad components - the physical infrastructure and the institutional infrastructure. The former is comprised of factors of production or all tangible resources used in production, while the latter encompasses the environment for economic exchange. Three broad approaches have been used to address issues associated with the physical infrastructure in the aftermath of a disaster: economic resource assessments; the use of formal economic models to simulate the performance of a postdisaster economy; and individual industry studies. Three conclusions were drawn. First, the magnitude of potential destruction of economic resources under hypothetical disaster scenarios has been documented. Second, problems that could potentially thwart economic recovery have been detailed. Third, the economic conditions under which recovery is likely to occur have been formulated. Research on the institutional infrastructure has been assessed in the context of the reconstruction of the German economy following World War II. The primary recommendation is that further analysis should be undertaken to develop an organization and stabilization program that is consistent with fiscal and monetary reform

and damage compensation. The program should place less emphasis on central administration and price controls than some observers have argued.

41092 **(PB—87-190377/XAB) Central Nevada Development Authority final report.** (Central Nevada Development Authority, Ruth (USA)). Dec 1986. 357p. NTIS, PC A16/MF A01.

Color illustrations reproduced in black and white.

The five member counties (White Pine, Lincoln, Eureka, Nye, and Mineral) of the Central Nevada Development Authority (CNDA) have traditionally relied upon mining and mineral processing industries for their economic bases. Consequently, the prosperity of these counties has been tied to the boom and bust cycles characteristic of these two industries. The purpose of this project was to assist CNDA to identify long-term economic-diversification strategies, implement initial phases of those strategies, and identify means to provide on-going economic-development programs. The report includes copies of a local business and industry directory, a regional marketing strategy, a listing of SIC industries with the most potential for expansion in CNDA's service area, a geothermal resources inventory, and a procurement opportunities analysis.

2903 Environment, Health, And Safety

REFER ALSO TO CITATION(S) 40416, 40501, 40940, 41116, 41203, 41205, 41250, 41873, 41887, 41888, 41899, 41917, 41920, 41921, 41922, 41923, 41924, 41925, 41943, 41944, 41964, 41965, 41966, 41967, 41968, 41969, 41990, 41991, 41992, 41993, 41994, 41995, 41996, 42012, 42015, 42030, 42034, 42196

41093 **(NP—7770182) Determinants of the development and use of environmentally acceptable novelties in industrial firms. Theoretical deliberations and first empirical evidence.** Maas, C. (Technische Univ. Berlin (Germany, F.R.). Wirtschaftswissenschaftliche Dokumentation). 1986. 203p. (In German). NTIS (US Sales Only), PC A10. File Number DE87770182.

A comprehensive analysis of the determinants of the innovative behaviour of industrial firms is used in the firm's decision-making process. A basic pattern of the firm's innovative processes is shown and a survey is given of the determinants of length and the results of the individual phases. The need for research and attempts at further research are described.

41094 **(ORNL—6405/R1) Environmental regulatory update table.** Brown, K.J.; Langston, M.E.; Tucker, C.S.; Reed, R.M. (Oak Ridge National Lab., TN (USA)). Jun 1987. Contract AC05-84OR21400. 96p. NTIS, PC A05/MF A01; GPO Dep. File Number DE87013362.

Environmental Sciences Division Publication No. 2958.

The Environmental Regulatory Update Table provides information on regulatory initiatives of interest to DOE operations and contractor staff with environmental management responsibilities. The table is updated each month with information from the Federal Register and other sources, including direct contact with regulatory agencies. Each table entry provides a chronological record of the rulemaking process for that initiative with an abstract and a projection of further action.

41095 **(PB—87-186490/XAB) Environmental Fate Data Base (ENVIROFATE): chemical name file (CASLST), February 1987. Data file.** Boethling, R. (Environmental Protection Agency, Washington, DC (USA). Office of Pesticides and Toxic Substances). Feb 1987. mag tap. (EPA—560/5-86/014A). NTIS CP T02.

Supersedes PB—87-139283; Source tape is in the ASCII character set. This restricts preparation to 9 track, one-half inch tape only. Identify recording mode by specifying density only. Call NTIS Computer Products if you have questions.

The tape includes the chemical name, molecular formula, and CAS registry number for each chemical added to the ENVIROFATE database by these supplements. The tape is to be used in conjunction with DATALOG, BIOLOG, CHEMFATE and XREF files (transmitted together with these) in order to link chemical names and formulas to the CAS registry numbers contained in DATALOG, BIOLOG, and CHEMFATE. The CASLST file consists of three fields: (1) Chemical Abstract Service Registry Number (CAS) which is numerical and 9 bytes in length; (2) Chemical formula (FOR) which is textural and 23 bytes in length; and (3) Chemical name (CNA) which is textural and 48 bytes in length.

41096 **(PB—87-186508/XAB) Environmental Fate Data Base (ENVIROFATE): data pointer file (DATALOG), February 1987. Data file.** Boethling, R. (Environmental Protection Agency, Washington, DC (USA). Office of Pesticides and Toxic Substances). Feb 1987. mag tap. (EPA—560/5-86/014B). NTIS CP T02.

Supersedes PB—87-139291; Source tape is in the ASCII character set. This restricts preparation to 9 track, one-half inch tape only. Identify recording mode by specifying density only. Call NTIS Computer Products if you have questions.

DATALOG is a bibliographic pointer file of environmental fate data and each record contains a chemical CAS registry number (9 bytes), one of 18 data types (9 bytes), and a reference number (6 bytes) to the full citation in the XREF file. The data types identify physical properties, degradation and transport studies, and food, occupational and ambient monitoring data. The file should be used with CASLST (in order to link the chemical name and formula) and XREF (in order to link the full reference citation). A list of possible data types and their abbreviations are: Adsorption (ADSORP), Bioconcentration (BIOCON), Biodegradation (BIODEG), Dissociation constant (DISS CON), Ecosystem (ECOS), Effluent concentrations (EFFL), Evaporation from water (EVAP), Food and crop concentrations (FOOD), Field studies (FIELD), Henry's Law constant (HENRY CON), Hydrolysis (HYDROL), Monitoring (MONIT), Occupational concentrations (OCCUP), Octanol/water partition coefficient (O/W PART), Photoxidation (PHOTOOXID), UV Spectra (UV), Vapor pressure (UP) and Water solubility (WATER SOL).

41097 **(PB—87-186516/XAB) Environmental Fate Data Base (ENVIROFATE): microbial degradation/toxicity data (BIOLOG), February 1987. Data file.** Boethling, R. (Environmental Protection Agency, Washington, DC (USA). Office of Pesticides and Toxic Substances). Feb 1987. mag tap. (EPA—560/5-86/014C). NTIS CP T02.

Supersedes PB—87-139309; Source tape is in the ASCII character set. This restricts preparation to 9 track, one-half inch tape only. Identify recording mode by specifying density only. Call NTIS Computer Products if you have questions.

BIOLOG is a bibliographic pointer file of microbial biodegradation/toxicity data. Each record contains a Chemical Abstract Services Registry Number (9 bytes), a string of data codes (total of 10 bytes) and a reference number (6 bytes). The string of data codes is divided into (1) an indication of biodegradation (B) or microbial toxicity (T) data (1 byte); (2) oxygen condition - aerobic (AE) or anaerobic (AN) (2 bytes); (3) culture type - pure enzyme (PE), pure culture (PC), mixed culture (MC), or cell-free extract (CF) (2 bytes); (4) source of microorganism - soil (SOI), sediment (SED), sewage (SEW), fresh water (WAF), marine water (WAM) or other (OTH) (3 bytes); (5) whether the pathway of degradation was (R) or was not (blank) studied (1 byte); and (6) data source - DATALOG (D) or various files from Dr. Martin Alexander at Cornell University (H, M, G, A, or P) (1 byte). The file should be used with CASLST (in order to link the chemical name and formula) and XREF (in order to link the full reference citation).

41098 **(PB—87-188918/XAB) Superfund risk assessment information directory. Final report.** Zamuda, C. (Environmental Protection Agency, Washington, DC (USA). Office of Emergency and Remedial Response). Nov 1986. 200p. (EPA—540/1-86/061). NTIS, PC A09/MF A01.

See also PB—87-183125.

The Directory identifies and describes sources of information useful in conducting Superfund-related risk assessments. Information is presented on sources of automated data bases, data files and tapes, models, directories, periodicals, publications, and on human and corporate resources. The purpose of the Directory is to facilitate the performance of EPA-related risk assessments by helping individuals find needed information and specialized resources.

41099 **(PB—87-189270/XAB) Health-hazard evaluation report HETA-83-085-1757, Everglades National Park, Everglades, Florida.** McConnell, R.; Fidler, A.T.; Chrislip, D. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Dec 1986. 107p. (HETA—83-085-1757). NTIS, PC A06/MF A01.

Adverse health effects from exposure to N,N-diethyl-m-toluamide (DEET), and insect repellant, in employees of Everglades National Park, Florida were investigated in response to a request from the National Park Service. Neurobehavioral analysis showed significant correlations between DEET exposure and affective symptoms, insomnia, muscle cramps, and urinary hesitation. The authors conclude that skin rashes, daytime sleepiness, and impaired cognitive function are significantly associated with DEET exposure. Since a safe alternative is not available, it is recommended that exposure be minimized by using lower concentrations and making use of protective clothing.

41100 **(PB—87-195343/XAB) Status report on the US national dioxin study.** Barnes, D.; McBride, A.; Jaworski, N.; Harless, R.; Dupuy, A. (Environmental Protection Agency, Narragansett, RI (USA). Environmental Research Lab.). 1986. 6p. (ERLN-P—1). NTIS, PC A02/MF A01.

Pub. in Chemosphere, Vol. 15, No. 9-12, 1401-1404(1986).

In 1983, the U.S. Environmental Protection Agency (EPA) embarked on an extensive investigation of the presence and extent of contamination of the national environment by chlorinated dibenzo-p-dioxins and dibenzofurans (CDDs/CDFs). The status report is a prelude to a final report delivered to the U.S. Congress in December 1985.

41101 **OMB review of EPA regulations. Hearing before the Subcommittee on Oversight and Investigations of the Committee on Energy and Commerce, House of Representatives, Ninety-Ninth Congress, Second Session, May 8, 1986.** Washington, DC; Government Printing Office (1986). 375p.

Two representatives of the Office of Management and Budget (OMB) testified at a hearing held to examine OMB's practicing of vetoing without legislative authority the decisions of regulated agencies. At issue was the secrecy with which OMB performs its reviews, and which increases the opportunity for abuse. Specific concerns were the OMB's record of allowing special interests to circumvent the regulatory process in cases involving asbestos the difficulty of obtaining public records. Wendy Gramm, Administrator of the Office of Information and Regulatory Affairs of OMB defended the President's Executive Order No. 12291 as appropriate and within constitutional limits. Material submitted from OMB and the Investigations Subcommittee follows the testimony.

2904 Natural Resources

41102 **(PB—87-190617/XAB) Economic evaluation of conservation concepts for municipal water-supply systems.** Hughes, T.C.; Narayanan, R.; McKee, M.; Bishop, A.B.; LeConte, R. (Utah State Univ., Logan (USA). Utah Water Research Lab.). Sep 1986. 156p. NTIS, PC A08/MF A01.

Five concepts for conservation of municipal water supply are analyzed from an economic efficiency perspective. They include: (1) seasonal pricing (for reduction of peak period water use); (2) dual water systems (separate high-quality drinking water and untreated outdoor irrigation systems); (3) imported water transmission facility capacity optimization; (4) flow restricting devices; and (5) short-term rationing concepts. Optimization models, including generalized model generators, were developed for analysis of the first three concepts, and model applications to cities in Utah were demonstrated for each. The flow-restricting device and short-term rationing concept analyses were based upon approaches taken from the literature but applied to example sites in Utah. The final chapter is a comparison of results and summary of conditions that favor each approach to conservation.

2905 Research, Development, Demonstration, And Commercialization

REFER ALSO TO CITATION(S) 40721, 42808

41103 **(AD-A—180570/4/XAB) Methodologies used by Warsaw Pact countries (except USSR) in obtaining US technologies. Student report.** Cheeseman, R.J. (Air Command and Staff Coll., Maxwell AFB, AL (USA)). Apr 1987. 47p. (ACSC—87-0490). NTIS, PC A03/MF A01.

The Warsaw Pact countries obtain U.S. technologies by legal and illegal means. Methods of collection include espionage, overt collection, acquisition by scientific and educational exchange participants, and illegal trade activities. Examples of methods used by the Warsaw Pact countries (except the USSR) are provided. The US faces barriers to preventing loss of its technologies. Among these are resistance from US business interests, insufficient cooperation between US government agencies and overseas allies, lack of US counterintelligence personnel, and the openess of American society. The study concludes that the Warsaw Pact's countries have narrowed NATO's qualitative lead in weaponry as a result of the Warsaw Pact's acquisition effort.

41104 **(CONF-8706111—3) Impact of the energy-related inventions program on the national economy.** Brown, M.A.; Morell, J.A.; Snell, S.A.; Kerley, C.R. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011663.

From 12. annual meeting and international symposium of the Technology Transfer Society; Washington, DC, USA (22 Jun 1987).

The market entry, sales, and employment data presented in this paper suggest that ERIP has been able to efficiently produce positive economic impacts. It is likely that the documented successes of ERIP's inventors will be even greater as their projects mature and more current commercialization information is collected. Survey data presented elsewhere indicate that the ERIP financial support, endorsement, encouragement, and commercialization education are viewed by participants as the most important benefits of the program (Brown, Morell, Snell, Soderstrom, and Friggle, 1987). Other federal, state, and local programs might profit substantially from modelling the composition and delivery of their assistance after the Energy-Related Inventions Program.

41105 **(PB—87-190856/XAB) Technology transfer: a strategy for innovation adoption at the Washington State Department of Transportation. Final report.** Brooks, R.L. (Washington State Transportation Center, Seattle (USA)). Dec 1986. 109p. NTIS, PC A06/MF A01.

The study was initiated as part of a department-wide strategic planning effort of the Washington State Department of Transportation to assess whether a coordinated technology transfer program will enhance innovation adoption. Interviews with WSDOT employees in all divisions and districts provide the basis of an inventory of current technology practices. A literature review describes the process of technology transfer and the issues relating to an individual's ability to adopt innovation. Additionally, the structure of the organization and the barriers to innovation adoption are discussed based on information obtained from a literature review. Examples of technology transfer programs in other organizations are described to understand how the process is used to adopt innovation. Based on the employee interviews, and the literature review, specific recommendations and implementation plans are provided in the report.

2906 Nuclear Energy

REFER ALSO TO CITATION(S) 40501, 40600, 40891, 41079, 41080, 41277, 42196

41106 **(IAN—1985) Progress report 1985.** (Instituto de Asuntos Nucleares, Bogota (Colombia)). 1986. 56p. (In Spanish). NTIS (US Sales Only), PC A04/MF A01. File Number DE87702737.

The document informs about the activities made by the Institute of Nuclear Affairs (Colombia) during 1985.

41107 **(IAN—1986) Progress report 1986.** (Instituto de Asuntos Nucleares, Bogota (Colombia)). Feb 1987. 56p. (In Spanish). NTIS (US Sales Only), PC A04/MF A01. File Number DE87702738.

The document informs about the activities made by the Institute of Nuclear Affairs (Colombia) during 1986.

41108 **(NUREG—0750-Vol.24-No.3) Nuclear Regulatory Commission issuances, September 1986.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Technical Information and Document Control). Sep 1986. 99p. NTIS, PC A05/MF A01 - GPO. File Number TI87900556.

This report includes the issuances received during the specified period from the Commission (CLI), the Atomic Safety and Licensing Appeal Boards (ALAB), the Atomic Safety and Licensing Boards (LBP), the Administrative Law Judge (ALJ), the Directors' Decisions (DD), and the Denials of Petitions for Rulemaking (DPRM).

41109 **(PAPO—87-06) Nuclear standards: Master index.** (Oak Ridge National Lab., TN (USA)). 30 Jan 1987. Contract AC05-84OR21400. 52p. Performance Assurance Project Office, Bldg. 9204-1, MS-10, Oak Ridge, TN 37831 . File Number TI87004573.

This index provides a complete list, organized by standard numbers, of all assigned NE numbers, their title, issue date, amendment number and date, issue date of the superseded standard if any, standards writer/cognizant engineer, DOE/cognizant engineer, and a remarks column which reflect the current status of the standard (see legend). The "Nuclear Energy Standards KWIC Index" of NE standards, also published by the Performance Assurance Project Office, should be consulted for information on standards when the assigned numbers are not known.

2910 Conservation

REFER ALSO TO CITATION(S) 41136, 41155, 41156, 41159, 41160, 41161, 41162, 41163, 41165, 41166, 41168, 41169, 41173, 41174, 41175, 41176, 41177, 41178, 41180, 41181, 41182, 41184, 41186, 41188, 41190, 41191, 41200, 41205, 41207, 41210, 41211, 41221, 41222, 41223, 41224, 41225, 41226, 41227

41110 **(EUR—10868-EN) Energy audit No. 7: Dairy industry in the European Economic Community. Final report.** (Commission of the European Communities, Luxembourg. Directorate General Information Market and Innovation). 1987. 158p. Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities.

After a review of energy consumption in the Community's dairy industry, energy conservation options are described, and exemplary calculations are presented. Recommendations are made for the practical implementation of these options. With 18 tabs., 35 figs.

2920 Supply, Demand, And Forecasting

REFER ALSO TO CITATION(S) 41114, 41155, 41157, 41158, 41255, 41256, 41257, 41258

41111 **(PB—87-188975/XAB) South African energy-demand model MEDSA. Special report.** Bitsakis, J.; Vermeulen, P.J. (Council for Scientific and Industrial Research, Pretoria (South Africa). National Research Inst. for Mathematical Sciences). Oct 1985. 43p. (CSIR-SWISK—41). NTIS, PC PC E05/MF E05.

A complete description of the South African energy-demand model, MEDSA, is presented. The model succeeds in reproducing the historical behavior of the South African energy system. It projects the long-term future behavior of the South African energy-demand system under various economic assumptions, and it can be used to assess the impact of various energy policies.

41112 **(PB—87-194262/XAB) Predicting conditional means of explanatory variables for energy-demand forecasting.** Parti, M.; Parti, C.B.; Gould, D.M.; Parris, K.M. (Applied Econometrics, Inc., Del Mar, CA (USA)). Nov 1984. 61p. NTIS, PC A04/MF A01.

The purpose of the research was to explore the feasibility of an economic and statistical approach to the problem of forecasting the conditional means of variables used to predict appliance-specific energy demand. The technique recognizes the necessity of using conditional means of explanatory variables, and it takes into account the changing distributions of these variables over time. Statistical relationships are used to derive the probability distribution of the explanatory variables, given ownership of an appliance such as a pool heater. The conditional means of the explanatory variables can then be calculated on the basis of this conditional probability distribution. The present research has found sizable differences in forecasts of appliance-specific energy demand generated from the conditional means approach and the non-specific approach.

41113 **(PB—87-194429/XAB) Energy demand analysis and alternative fuels. Transportation research record.** Dingemans, D.; Sperling, D.; Greene, D.L.; Hu, P.S.; Hallet, P. (National Research Council, Washington, DC (USA). Transportation Research Board). 1986. 54p. (TRB/TRR—1092). NTIS, PC A04/MF A01.

Library of Congress catalog card No. 87-1572.

Contents include: Mental maps and the refueling behavior of vehicle drivers; A functional form analysis of the short-run demand for travel and gasoline by one-vehicle households; An assessment methodology for alternative fuels technologies; Drive-up windows, energy, and air quality; Travel characteristics and transportation energy consumption patterns of minority and poor households; An investigation into the use of market segmentation analysis for transportation energy planning.

2930 Policy, Legislation, And Regulation

REFER ALSO TO CITATION(S) 40419, 40434, 40435, 40468, 40600, 40940, 41079, 41080, 41094, 41101, 41125, 41156, 41160, 41188, 41925, 42012

41114 **(NP—7770227) Energy programme '85.** (Ministerium fuer Wirtschaft, Mittelstand und Technologie des Landes Baden-Wuerttemberg, Stuttgart (Germany, F.R.)). 1985. 71p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE87770227.

The energy policy intentions of the Land government since 1968 are presented in the form of an official energy programme. This programme must fit into the framework of international and national energy policies. The current developments of energy supply and energy policy are summarized by the Ministry of Economy, Trade and Technology in its annual report for Baden-Wuerttemberg. The energy programme in hand continues the 1980 programme, which in turn succeeded the 1977 programme. On behalf of the above ministry, the Institute of Energy Economy of Cologne University prepared an expert opinion forecasting the energy requirements and supplies of Baden-Wuerttemberg up to the year

1995. This report has been published. The main results are taken into consideration in the energy programme 1985, but are treated as forecasts showing tendencies and magnitudes, and are not political targets. They do not relieve industry and consumers from their responsibility to judge the situation themselves, and take the suitable decisions.

41115 **(ORNL/M—393) Mid-term evaluation of USAID Sudan Energy Planning and Management Project (650-0059).** Jones, D.W.; Stovall, J.P.; Raby, J.G.; Younger, D.R.; Pryor, C.A. (Oak Ridge National Lab., TN (USA)). Jul 1987. Contract AC05-84OR21400. 223p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE87013343.

The Energy Planning and Management (EPM) Project was designed to increase reliability of the Blue Nile Grid and to bolster the management and operation of the National Electricity Corporation (NEC) and the General Petroleum Corporation (GPC), and to help develop the National Energy Administration (NEA) as a national energy planning institution. Two major successes are already in evidence at NEC at mid-project. The Blue Nile Grid reliability has improved from a low of 74% in 1983 to 94% currently; although the EPM project has not been the only influence, its maintenance activities have been partly responsible for this improvement. Accomplishments of NEA and NEC are described.

2940 Fossil Fuels

REFER ALSO TO CITATION(S) 40402, 40415, 40419, 40434, 40435, 40468

41116 **(DOE/FE—0090) Public meetings for views and comments on the conduct of the Innovative Clean Coal Technology Solicitation: Background information, Albuquerque, New Mexico, August 13, 1987; St. Louis, Missouri, September 3, 1987; Pittsburgh, Pennsylvania, September 10, 1987; Washington, DC, September 22, 1987.** (USDOE Assistant Secretary for Fossil Energy, Washington, DC). Aug 1987. 130p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87013416.

This document gathers public notice items from the Federal Register; Department of Energy News Releases; and Congressional testimony related to Clean Coal Technology solicitation. (PSB)

2950 Hydrogen And Synthetic Fuels

REFER ALSO TO CITATION(S) 41113

2960 Electric Power

REFER ALSO TO CITATION(S) 41155, 41159, 41161

41117 **(DOE/EIA—0397(87/1Q)) Electric power quarterly, January-March 1987.** (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). 27 Jul 1987. 349p. NTIS, PC A15/MF A01 - GPO; 1; GPO Dep. File Number DE87013433.

In this report, data collected on Form EIA-759 regarding electric utilities' net generation, fuel consumption, and fuel stocks are presented on a plant-by-plant basis. In addition, quantity, cost, and quality of fossil fuel receipts collected on the Federal Energy Regulatory Commission (FERC) Form 423 are presented on a plant-by-plant basis. The report also presents a quarterly summary of disturbances and unusual occurrences affecting the electric power industry collected by the Office of International Affairs and Energy Emergencies (IE) on the Form IE-417.

41118 **(DOE/EIA—0455(85)) Historical plant cost and annual production expenses for selected electric plants, 1985.** (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). 15 Jun 1987. 275p. NTIS, PC A12/MF A01 - GPO; 1; GPO Dep. File Number DE87011017.

Selected hydroelectric, fossil-fueled steam-electric, gas-turbine, and nuclear steam-electric plants in commercial operation by electric utilities are studied. The annual production expenses to electric utilities of producing electric power at these plants are presented. These expenses do not include annual fixed charges on plant cost (capital cost) such as interest on debt, depreciation, amortization expenses, and taxes. Plants were selected mainly on the basis of their net generation. Data are for 100% of plant ownership unless indicated otherwise. Where plant data are reported for less than 100% ownership, individual line items may not be equal to the total reported ownership. Historical Plant Cost is a summary of the utility's net cumulative-to-date actual outlays or expenditures for land, buildings, and equipment plus the costs of all plant additions, less the value of retirements. "Power Production Expenses" cover plant operation and maintenance, including fuel for the reporting year. These expenses do not include annual fixed charges on plant cost (capital costs) such as interest on debt, depreciation or amortization expenses, and taxes. Consequently, total production expenses and the derived unit costs are not the total cost of producing electric power at the various plants.

41119 **(EPRI-EM—5297-SR) Roles of electricity: A brief history of the beginnings of electroprocessing from the 1880s to the 1930s.** Devine, W.D. Jr. (Oak Ridge Associated Universities, Inc., TN (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jul 1987. 24p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920529.

Commercial production of electricity began in 1882. During the ensuing quarter century, practical processes that depend uniquely on electricity ("electro-processes)) were developed for manufacturing a number of chemicals and metals. Some electroprocesses could produce substances such as aluminum, chlorine, and silicon carbide that were not previously available commercially and that became of great importance to society. Other electroprocesses yielded materials that were already available - caustic soda and phosphorus, for example; but electric methods of making these products were vastly superior to chemical methods and soon replaced the older processes entirely and offered significant improvements in labor and capital productivity. By the 1920s, major industries centering on electroprocesses had grown and matured. There are striking parallels between the impact of electric motors on American manufacturing and the impact of electroprocesses. 41 refs.

41120 **(EPRI-EM—5298-SR) Roles of electricity: A brief history of electricity and the geographic distribution of manufacturing.** Barkenbus, J.N. (Oak Ridge Associated Universities, Inc., TN (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jul 1987. 25p. Reserach Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920530.

Because of its versatility and ease of transmission, electricity has been instrumental in opening all regions of the country to manufacturing opportunities. This report briefly examines the historical role of electricity in permitting the geographic dispersion of manufacturing activities. 26 refs.

41121 **(EPRI-EM—5308) Valuing demand-side planning information: Final report.** Swift, M.A. (Economic Systems Research Associates, Oakland, CA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jun 1987. 43p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920476.

The objectives of this project are to develop and demonstrate a method to determine the value of demand-side data and information. The method is a straightforward use of the decision analysis approach to the value of information: a decision, such as generation construction, is analyzed under conditions of uncertainty to determine the net present value; demand-side information is introduced that reduces the uncertainty or provides additional decision alternatives; the decision is reevaluated using the new information and the change in the net present value of the decision is the value of the demand-side information. Use of the method is demonstrated through application to a range of simple but realistic example decisions, using actual utility data wherever possible. The method is readily usable and can provide dramatic insights. The results indicate that the value of demand-side information is potential-

ly very great - as much as fifty to a hundred million dollars in some examples - and generally is at least an order of magnitude larger than the cost, with a payback period of a year or less. 12 figs., 1 tab.

41122 **(EPRI-P—5233-CCM) OVER/UNDER Capacity Planning Model, Version 3: User's guide.** Clark, C.E. Jr.; Fancher, R.B.; Guardino, T.E.; Kesselman, L.E.; Wilson, D.S. (Decision Focus, Inc., Los Altos, CA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jul 1987. 290p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920532.

This Users Guide is designed to facilitate the application of the Over/Under Capacity Planning Model Version 3.0 to specific utility systems. The model was developed in EPRI project RP 1107 for assessing the total cost to consumers and returns to shareholders of varying levels of planning reserve margin (or planning capacity margin) under conditions of uncertain future demand. This version of the Over/Under Model represents an expansion of the methodology described in the October 1978 EPRI report EA-927, Costs and Benefits of Over/Under Capacity in Electric Power System Planning. The Users Guide contains a description of the model's component modules, instructions for operating the model, guidelines for interpreting results and suggested procedures for developing case studies. Detailed data input information is included in the body of the report and reproduced in a separate Quick Guide, which may be removed for use at the computer. A discussion of main program and subroutine logic is provided in an appendix. The appendixes also contain material describing the details of the model and present the history of model changes from Version 1.0 to today.

41123 (INIS-mf—10706, pp 1-28) **Development of thermal energy in Yugoslavia.** Prodanovic, M.; Sternisa, J. (Zajednica Jugoslavenske Elektroprivrede, JUGEL, Belgrade; Elektroinstitut Milan Vidmar, Ljubljana, Yugoslavia). 1986. (In German). NTIS (US Sales Only), PC A16/MF A01. File Number DE87752788. (CONF-8605275—).

From VGB special meeting on Yugoslavia; Bled, Yugoslavia (14 May 1986).

The paper describes the development of power generation in Yugoslavia since 1945. Starting from various issues like pollution control, secured supply, energy conservations in consumption, etc., the author studies further options for the development of the energy economy. This is followed by a description of the evolution of power production till 1984, and by estimates of required primary energy sources, of the evolution of power consumption and of the associated extension of thermal energy capacities till 2010. (HAG).

2980 Consumption And Utilization

REFER ALSO TO CITATION(S) 41155, 41157, 41158, 41159, 41160, 41170, 41171, 41172, 41200

41124 **(AD-A—180601/7/XAB) Tracked-vehicle fuel consumption. Final report on international test operations procedure.** (Army Combat Systems Test Activity (Prov.), Aberdeen Proving Ground, MD (USA)). 18 May 1987. 5p. (ITOP—2-2-603(1)). NTIS, PC A02/MF A01.

Supersedes report dated 6 Mar 87, AD-A178-192 and AD-A143-835.

This document describes procedures for evaluating the fuel efficiency of tracked vehicles under controlled operating conditions. The test data are a major source for comparisons with similar vehicles, and can also serve to predict the operational range of these vehicles during tactical missions.

2990 Unconventional Sources And Power Generation

REFER ALSO TO CITATION(S) 40720, 40721, 40732

41125 **Renewable energy industries. Hearing before the Subcommittee on Energy Conservation and Power of the Committee on Energy and Commerce, House of Representatives, Ninety-Ninth Congress, Second Session, December 16, 1986.** Washington, DC; Government Printing Office (1987). 157p.

Nine witnesses representing the renewable energy industries, investors, and government agencies testified at a hearing to review implementation of the Renewable Energy Industry Development Act (REIDA), which requires federal task force to help coordinate market development for the fledgling industry. At issue was the Reagan administration's policies to emphasize fossil and nuclear fuels at the expense of renewable energy sources. This has had a negative effect on both foreign and energy policy. The $6 billion-a-year industry must compete for international markets virtually without government support. The witnesses described how the industry has been faring. Material submitted in response to questions and other correspondence follows the testimony.

30 DIRECT ENERGY CONVERSION

3003 Thermoelectric Generators

41126 **(LA—10872-MS) General-Purpose Heat Source Safety Verification Test program: Edge-on flyer plate tests.** George, T.G. (Los Alamos National Lab., NM (USA)). Mar 1987. Contract W-7405-ENG-36. 24p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006309.

The radioisotope thermoelectric generator (RTG) that will supply power for the Galileo and Ulysses space missions contains 18 General-Purpose Heat Source (GPHS) modules. The GPHS modules provide power by transmitting the heat of ^{238}Pu α-decay to an array of thermoelectric elements. Each module contains four $^{238}PuO_2$-fueled clads and generates 250 W(t). Because the possibility of a launch vehicle explosion always exists, and because such an explosion could generate a field of high-energy fragments, the fueled clads within each GPHS module must survive fragment impact. The edge-on flyer plate tests were included in the Safety Verification Test series to provide information on the module/clad response to the impact of high-energy plate fragments. The test results indicate that the edge-on impact of a 3.2-mm-thick, aluminum-alloy (2219-T87) plate traveling at 915 m/s causes the complete release of fuel from capsules contained within a bare GPHS module, and that the threshold velocity sufficient to cause the breach of a bare, simulant-fueled clad impacted by a 3.5-mm-thick, aluminum-alloy (5052-T0) plate is approximately 140 m/s.

3004 Thermionic Converters

41127 **Co-sputtered thermionic cathodes and fabrication thereof.** Thomas, R.E.; Ritz, V.H. (to Secretary of the Navy, Washington, DC). US Patent 4,675,091. 23 Jun 1987. Filed date 16 Apr 1986. vp.

This patent describes a method of fabricating a thermionic cathode by cosputtering selected materials from one or more sources on a substrate surface under controlled conditions, comprising the steps of: introducing a substrate of material having a clean substrate surface into an ambient of reduced pressure with the substrate surface having a controlled temperature; cosputtering a mixture of materials, selected from the group consisting of alkaline earth oxides, aluminum oxide, magnesium oxide, and other oxides; these are admixed with refractory particles of metal selected from the group consisting of tungsten, iridium, osmium, rhenium, palladium, molybdenum, and other metals onto the clean substrate surface; controlled substrate surface temperatures as needed to build up on the substrate surface a layer of material containing refractory metal particles ranging in size from about 50 to about 200 Angstroms.

3005 Fuel Cells

REFER ALSO TO CITATION(S) 40883, 41126

41128 **(AD-A—180585/2/XAB) Analysis of fuel-cell power plants for DOD applications. Volume 2. Appendices. Final report, 3 February 1986-31 March 1987.** Taylor, R.W.; Sterrett, R.H.; Williams, E.R.; Londos, T.C. (Science Applications International Corp., San Diego, CA (USA). Energy Systems and Conservation Div.). Apr 1987. 301p. NTIS MF A01.

Availability: Microfiche copies only.

These appendices include APPENDIX A - Photographs of Ft. Yukon and Sparrevohn MAR Sites; APPENDIX B - Remote Sites Energy Data Sheets and Glossary of Terms; APPENDIX C - Daily Remote Site Data Reported on a Monthly Basis; Appendix D - Life Cycle Cost A alysis for Ft. Yukon; APPENDIX E - Life Cycle Cost Analysis for Sparrevohn; and APPENDIX F - Application Assessment Contracts Listing and Data Sheets.

41129 **(DOE/ER/45207—T1) Surface chemistry of electrocatalysts: Final report, May 1, 1985-April 30, 1986.** Hubbard, A.T. (Cincinnati Univ., OH (USA). Dept. of Chemistry). 3 Mar 1987. Contract FG03-85ER45207. 20p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012994.

Research on the following topics is reported: electrochemical hydrodesulfurization of organic compounds, effects of surface roughness on rates of formation of adsorbed intermediates, and electrodeposition of metals in catalytic amounts on surfaces. (DLC)

41130 **(DOE/NASA—0206-16) Organometallic catalysts for primary phosphoric acid fuel cells: Final report, 1981-1985.** Walsh, F. (ECO Energy Conversion, Somerville, MA (USA)). Mar 1987. Contract AI21-80ET17088. 92p. (NASA-CR—179490). NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87013415.

Cathode improvement, both in performance and cost, available through the use of a class of organometallic cathode catalysts, the tetraazaannulenes (TAAs), was investigated. A new mixed catalyst was identified which provides improved cathode performance without the need for the use of a noble metal. This mixed catalyst was tested under load for 1000 h in full cell at 160 to 200°C in phosphoric acid (H_3PO_4), and was shown to provide stable performance.

41131 **(LA-UR—87-2285) Analysis and interpretation of ac impedance data for porous electrodes.** Springer, T.E.; Raistrick, I.D. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 15p. (CONF-870560—4). NTIS, PC A02. File Number DE87013143.

From 171. Electrochemical Society meeting; Philadelphia, PA, USA (10 May 1987).

Ac impedance spectroscopy has been used to measure the dynamic response of two types of porous gas-diffusion oxygen electrodes in a sulfuric acid electrolyte. Models were developed based on flooded and on thin-film pore structure. The transfer functions of these structures were calculated and the impedance result fitted to the models using a nonlinear least squares program. The results were used to assess the adequacies of the models.

41132 **(LA-UR—87-2393) Fuel cells for extraterrestrial and terrestrial applications.** Srinivasan, S. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 32p. (CONF-870560—3). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013160.

From 171. Electrochemical Society meeting; Philadelphia, PA, USA (10 May 1987).

The fuel cell is a nineteenth century invention and a twentieth century technology development. Due to the high power and energy density, high efficiency, reliability, and production of pure water, hydrogen-oxygen fuel cell systems have no competition as auxiliary power sources for space vehicles. The alkaline fuel cell system is a well developed and proven technology for this application. The solid polymer electrolyte system may be its future competitor. The energy crisis of 1973 stimulated research, development and demonstration of the phosphoric acid, molten carbonate, solid oxide and solid polymer electrolyte fuel cell systems using natural gas, petroleum or coal derived hydrogen (and carbon monoxide for the high temperature systems) for terrestrial applications. The direct methanol-air fuel cell is still an electrochemist's dream. Though considerable technological advances have been made, the present price of crude oil, and the high capital costs and limited lifetime of fuel cell systems impede their terrestrial applications in the developed countries. Conversely, the potential for lower capital costs of labor intensive manufacturing processes and the relatively higher fossil fuel prices make these systems more attractive for such applications in the developing countries. 11 refs.

41133 **Thin film electrode arrays for mapping the current-voltage distributions in proton-exchange-membrane fuel cells.** Rieke, P.C.; Vanderborgh, N.E. (Electronics Div., Los Alamos National Lab., Los Alamos, NM). *Journal of the Electrochemical Society;* **135**: No. 5, 1099-1103(May 1987).

An array of reference electrodes was fabricated on a polyperfluorosulfonic acid membrane using microlithographic techniques. This array was used to map the current-voltage distribution at a proton exchange membrane fuel cell anode. Inhomogeneity in the voltage distribution was attributed to nonuniform humidification of the electrode, resulting in a decrease in halt-cell performance. Details of the fabrication method and the theory behind the array concept are presented.

41134 **Moving forward with fuel cells.** Stewart, J. (Northeast Utilities, the Gas Research Institute, the National Aeronautics and Space Administration and Argonne National Lab., IL). *AGA Monthly;* **69**: No. 3, 25-28(Mar 1987).

What is a fuel cell? Basically, it's an electrochemical device in which the chemical energy of a fuel, such as hydrogen, is converted directly and efficiently into electricity. A fuel cell has three major parts: an anode (negative electrode), an electrolyte (an ion conduction material) and a cathode (positive electrode). Unlike the more familiar dry cell and lead-acid batteries in which the chemical energy source is contained within the battery, a fuel cell depends on an outside supply of fuel and oxidant fed to it as needed to produce energy. In most fuel cells being developed today, hydrogen is used as the fuel and oxygen or air is used as the oxidant.

3008 Miscellaneous Converters

REFER ALSO TO CITATION(S) 40699

41135 **(AD-A—180276/8/XAB) Thermal and dynamical effects on electrodynamic space tethers. Final report.** Prall, J.S. (Army Military Personnel Center, Alexandria, VA (USA)). 8 May 1987. 139p. NTIS, PC A07/MF A01.

Electrodynamic tethers are essentially long conducting wires which, when deployed from an orbiting satellite, can generate power by converting orbital mechanical energy into electrical energy for use on the satellite. They can accomplish this as a consequence of the electrodynamically induced voltage caused by the movement of the tether with respect to the earth's magnetic field; this acts to drive a current through the tether to an on-board load. Conversely, if current is forced through the tether from the satellite, the electrodynamic interaction will induce a force and allow the tether to perform as a so-called Alfven engine. An analytical and numerical analysis was carried out on the operation of an electrodynamic tether system used for power generation and/or thrusting in a space environment. Three problems were examined. First, the efficiency of an uninsulated tether of prescribed design, as determined by the magnitude of current leakage along its length due to positive ion capture and secondary electron emissions, was compared to that of a perfectly insulated tether of identical design. Second, the effects on system efficiency of variations in the design parameters of the tether and the orbit in which it operates were examined by means of a numerical analysis of the thermal balance of the system. Third, the effects that the mode of operation of the tether has on the classical elements of the orbit in which it operates were examined through a numerical analysis.

32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

REFER ALSO TO CITATION(S) 40781

3201 Buildings

REFER ALSO TO CITATION(S) 40726, 41910, 41911

41136 **(AD-A—180490/5/XAB) User guide for single-building controllers.** Canfield, K. (Naval Civil Engineering Lab., Port Hueneme, CA (USA)). Apr 1987. 198p. NTIS, PC A09/MF A01.

A tremendous opportunity exists for the Navy to save energy used for heating and cooling buildings by using single-building controllers. Thompson Laboratory at China Lake NWC, California is one example. A single-building controller was installed with pre- and post-metering. A simple pulley change on the air-handling units resulted in a 40% energy savings. The single-building controller contributed another 40% savings, resulting in a payback of 6 months with a total cost of $20,000.00. There was no impact on comfort and all building ventilation requirements were met. A few prerequisites are necessary for effective installation of single-building controllers. One person needs to be excited about energy conservation and willing to work. That person needs the support of the commander and active cooperation from the building occupants. Buildings that are suitable for single-building controllers are those that consume at least $10,000.00 of energy a year for heating and cooling, are not occupied on a 24-hour basis, and do not have temperature-sensitive equipment or material inside the building. Excellent candidate buildings are administration and office buildings.

41137 **(BMFT-FB-T—86-164) Development of highly porous CSH materials with extremely low thermal conductivity. Final report.** Lippe, K.F. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Ytong A.G., Schrobenhausen (Germany, F.R.). Hauptlabor). Dec 1986. 104p. (In German). NTIS (US Sales Only), PC A06. File Number DE87770214.

The task was to modify the macrostructure as well as the microstructure of porous calcium silicate materials in such a way as to develop building materials with very low thermal conductivity without detriment to other important construction properties. The thermal conductivity of aerated lightweight concrete (ALC) can be influenced by varying the ratio between quarzite and binders. Only impurity ions in the form of alkalies lower thermal conductivity but they also deteriorate other quality characteristics. Other impurity ions were only able to modify properties like strength, shrinkage, etc. By using waste material, e.g. fly ashes, the thermal conductivity can be reduced but the resulting problem of strength has not yet been solved. The influence of porosity on the thermal conductivity of ALC lies within the test scattering. The theoretical assumptions of the research project could partly be confirmed. A transfer into practice, however, is still opposed by problems of profitability or negative influences on other quality characteristics. With 94 refs., 28 tabs., 79 figs.

41138 **(BMFT-FB-T—86-166) Development of an absorption heat pump installation driven by primary energy for use as heating system in residential buildings. Final report.** Schrader, K.H. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Stiebel Eltron G.m.b.H. und Co. KG, Holzminden (Germany, F.R.)). Dec 1986. 97p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE87770217.

Computer-aided tests for an optimization of components were carried out at a component testing facility. The results showed high mean annual heat conditions, which were confirmed also after an extensive reduction of the manufacturing costs by modification of components. At the highest possible mean concentration of the solution there is for each operating point of the installation an optimal degasifying breadth, which requires volume flow regulation of the rich and the weak solution parallel to the continuous control of the burner output. The test of a water to water compact installation confirmed the results of the component testing station. An unexpectedly fast progressive deterioration of the binary mixture R 22-E 181 in the component testing station disproved the hitherto observed stability of the solution; the same deterioration after corresponding operation times in the compact installation demonstrates a systematic cause for failure. All subsequent examinations pointed to thermal failure, whereupon basic tests have to be carried out to determine thermal limiting values. With 16 refs., 27 figs.

41139 **(BMFT-FB-T—86-170) Parameter study and simplified calculating procedures for the optimization of window design in terms of energy consumption and economy. Final report.** Balkowski, M. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Schmidt-Reuter Ingenieurgesselschaft m.b.H. und Co. K.G., Koeln (Germany, F.R.)). Dec 1986. 133p. (In German). NTIS (US Sales Only), PC A07. File Number DE87770213.

This research project required work on simplified calculating procedures to determine energy consumption, average annual costs, and the winter and summer room climate. After comprehensive research of literature on the calculating procedures developed so far it became evident that a comprehensive parameter study with a simulation programme on an hourly basis was needed in order to develop a procedure for determining the room climate in summer, simple algorithms being derived from the study by means of regression analysis. These algorithms, the procedure for determining energy consumption, which is based on monthly reviews, and the dynamic economy calculation have been implemented on a commercially available personal computer. In addition, optimization programmes were developed and implemented after comprehensive market research on window components. The completed programme for window optimization on dwelling houses allows the user to optimize window size and design with regard to energy consumption, annual costs or room climate in summer. Calculations can also be made using any data as desired, so as to evaluate any wishes the customer may have or any design concepts on the part of the architect in comparison with the optimum window size/window design. With 16 refs., 9 tabs., 58 figs.

41140 **(CONF-870811—3) Hood River Conservation Project load analysis.** Stovall, T.K. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 7p. NTIS, PC A02. File Number DE87011184.

From Energy conservation program evaluation: practical methods and useful results; Chicago, IL, USA (19 Aug 1987).

A load analysis was performed to determine the capacity savings attributable to the conservation retrofits installed by the Hood River Conservation Project. The load savings were significant and were available at the system peak load periods. A small degradation in load factor was noted. The amount of time at peak loads was reduced as well as the magnitude of the diversified residential peak. Savings were greatest in single family electrically heated homes.

41141 **(CONF-870811—4) The Hood River Conservation Project: Participation, installation of measures, and electricity savings.** Hirst, E.; Goeltz, R. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 11p. NTIS, PC A02/MF A01. File Number DE87012250.

From Energy conservation program evaluation: practical methods and useful results; Chicago, IL, USA (19 Aug 1987).

The Hood River Conservation Project (HRCP) was a major residential retrofit project, intended to test the upper limits of a utility retrofit program. It was proposed by the Natural Resources Defense Council, funded by the Bonneville Power Administration (Bonneville) and operated by Pacific Power and Light Company (PP and L) in Hood River, Oregon. This five-year, $20 million research and demonstration project installed as many cost-effective conservation measures in as many electrically heated homes in Hood River as possible. The measures were aimed at the building shell to reduce electricity use for space heating and at water heating retrofits; no heating or water heating equipment was replaced. The purpose of the evaluation summarized here was to determine the Project's performance in three critical areas: the number of eli-

gible households that participated, the number of recommended conservation actions adopted by participants and financed by HRCP, and the actual electricity use and savings achieved by HRCP.

41142 **(CONF-8709111—1) Guidelines for retrofit performance monitoring.** Ternes, M.P. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012539.

From 4. annual symposium on improving building energy efficiency in hot and humid climates; Houston, TX, USA (15 Sep 1987).

A data specification guideline developed for use in the US Department of Energy (DOE) Single-Family Building Energy Retrofit Research Program is applicable to field monitoring studies of cooling retrofits. The guideline was developed to promote the collection of data (more detailed than billing data) that are needed to fully understand retrofit energy performance. The guideline identifies the important data parameters that should be collected to meet this need and defines the data parameters to ensure that consistent and comparable data are collected. The purpose of this paper is: (a) to summarize the data parameters identified in the guideline; and (b) to discuss low-cost instrumentation that can be used to monitor the data parameters identified in a minimum data set.

41143 **(DOE/BP—833) Builder's guide: Your guide to super cents construction and sales.** (Bonneville Power Administration, Portland, OR (USA)). Jun 1987. 22p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87013419.

This Builder's Guide describes the Super Good Cents program and the benefits available to participating builders. It explains the program standards and the typical building techniques used by Super Good Cents builders. Finally, the Guide tells how one can participate and answers many of the questions asked by builders about the Super Good Cents program.

41144 **(DOE/BP/31011—1) Model Conservation Standards: Construction cost evaluation.** (Tacoma Office of Intergovernmental Affairs/Energy, WA (USA)). Jul 1987. Contract AP79-86BP31011. 75p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87011894.

This report presents the results of a study of construction costs for homes built to the Model Conservation Standards (MCS) in the Greater Tacoma area. The goal of this study was to gather cost information only for the elements of labor and materials for the components of homes that are affected by the implementation of these energy efficiency standards. There were four major elements to this study: (1) The development of a set of factors that could be used to calculate quantities of materials necessary to construct certain elements of single family residences. (2) A survey of building material suppliers in the Greater Tacoma area who supply homebuilders with various products that are incorporated into the thermal envelope and mechanical systems of new homes. (3) A survey of subcontractors to determine material and labor costs encountered by local homebuilders for services necessary to meet the Model Conservation Standards. (4) Case studies of homes built by homebuilders with various levels of experience in meeting the Model Conservation Standards.

41145 **(DOE/CE/63490—T5) Feasibility study on polyurethane foam roofing insulation business.** Morris, C. (Amador-Tuolumne Community Action Agency, Jackson, CA (USA)). 4 May 1987. Contract FG01-86CE63490. 95p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87013405.

The Amador-Tuolumne Community Action Agency has evaluated the feasibility of starting a polyurethane foam roofing insulation business in the foothills counties of El Dorado, Amador, Calaveras, Tuolumne and Mariposa. This idea evolved from ATCAA's efforts to insulate mobile homes through low-income weatherization programs. Thorough investigation of the product, market and financial requirements for this business indicate that the feasibility is questionable.

41146 **(EPRI-EM—5300) Heating, ventilating, and air conditioning of commercial buildings: Research workshop: Final Report.** Isaksen, L. (Analysis and Control of Energy Systems, Inc., Martinez, CA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jul 1987. 35p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920534.

Commercial building space heating and cooling represent significant current and potential energy sales and peak demands for electric utilities. Commercial building space heating and cooling technology improvements that increase the cost-effectiveness, efficiency, reliability, and load factor of this equipment and thus its value to electric utilities and their customers are therefore of great interest to electric utilities. As a step in its R & D planning process, the Electric Power Research Institute (EPRI) sponsored a workshop during which industry experts identified research needs in commercial building heating, ventilating, and air conditioning (HVAC) systems. Twenty-seven industry experts representing builders, contractors, dealers, distributors, research organizations, manufacturers, and electric utilities attended the one- and one-half day workshop held on August 12 and 13, 1986. Sessions covered all HVAC topics, but the emphasis was on heat pumps. This report summarizes the results of the workshop. Specific recommendations for research needs in the areas of components, applied or built-up systems, and unitary or packaged systems are included and ranked in order of priority.

41147 **(EPRI-EM—5328) Heat pump repair costs in Alabama: Final report.** Lovvorn, N.C.; Bartolucci, A.A.; Birch, R. (Alabama Power Co., Birmingham (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jul 1987. 33p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920533.

This report presents results of a study of heat pump service costs experienced by heat pump owners in Alabama. Service cost information, including all parts and labor, was extracted from detailed service records compiled by the Alabama Power Company (APCo) in their Assured Service Heat Pump Program, a 10-year maintenance contract program. The study was performed on nearly 18,000 heat pumps installed over a 20-year period representing seven major manufacturers. Significant results of the study are: Cumulative repair cost per heat pump for all heat pumps as a group over the most recent 10-year period is approximately $680 in 1985 dollars, or approximately $68 per year. Unit repair frequency has decreased significantly over the past two decades. For units installed as late as 1980, approximately 50% have required no repairs at all during the first 5 years of operation. Cumulative cost of repairing a heat pump during its first 5 years of service is steadily decreasing and is less for units installed since 1980 than for all units installed earlier. Improved reliability of heat pump components, including compressors in newer vintage units, is the primary reason for the observed reduced cumulative cost of heat pump repairs, when those costs are adjusted for inflation.

41148 **(EUR—10151) Performance of an absorption heat pump using an endothermic refrigerant/absorbent system.** O'Donnell, J.P. (Commission of the European Communities, Luxembourg). 1985. 68p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87752537.

The use of an endothermic solution in absorption heat pumps should lead to an increase in the value of the COP and to a reduction in the cooling load in the absorber. For a given heat pump duty the heat required in the generator would be reduced; and in the case of solar heating a smaller collector area would be required. The aims of the project are to investigate the feasibility of using an endothermic refrigerant/absorbent system in an absorption heat pump, and to evaluate the system. An earlier literature study of physico/chemical properties having led to the selection of potassium thiocyanate (KCNSO)/water for further study, heat capacity and vapour pressure have here been measured for KCNS/water solutions and an enthalpy-concentration chart for the system constructed. Further theoretical considerations suggest that aqueous endothermic solutions exhibit only small negative deviations from Raoult's law; and consequent adverse effects on the operation of a

heat pump are to be expected. Tests on a commercial absorption heat pump with KCNS/water solutions support this conclusion.

41149 (LBL—22151, pp 1.14-1.15) **Solid-state radiative heat pump.** Berdahl, P.; Khieu, C.; Ng, G. Mar 1987. NTIS, PC A02/MF A01. File Number DE87009270. Contract AC03-76SF00098.

In Energy Conversion and Storage Program: FY 1986, Annual report.

The objective of this project is to establish the research basis for the development of a new class of heat pump. This new heat pump will be a solid-state device that accepts input energy in the form of electricity and pumps infrared (heat) radiation across a thermally insulating gap. An important potential application is the heating and cooling of buildings, including applications using thermal storage. Semiconductor materials with direct narrow bandgaps in the range of 0.03-0.25 eV emit equilibrium thermal radiation which is in large part due to electron-hole recombination. An excess or deficit of infrared radiation, compared to the thermal equilibrium value, can be produced when the concentrations of electrons and holes are varied from their thermal equilibrium values by electrical means. Two techniques for varying the concentrations of electrons and holes are discussed.

41150 (LBL—22908) **Air-to-air heat exchangers and the indoor environment.** Vine, E. (Lawrence Berkeley Lab., CA (USA)). Feb 1987. Contract AC03-76SF00098. 15p. (CONF-870902—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006947.

From ICBEM '87: international congress on building energy management; Lausanne, Switzerland (28 Sep 1987).

Air-to-air heat exchangers were installed in 366 energy-efficient homes as part of a demonstration program in the United States. The median incremental cost of AAHX was $1268 ($7.42/m^2), and it was less expensive (per square meter) to install this equipment in larger houses than in smaller houses. While most occupants did not notice problems with their AAHX, some households did experience problems related to noise, unpleasant drafts, condensation around the AAHX, and core freezing. Occupants of energy-efficient homes were found to have less problems with their indoor environment (especially mildew/mold and condensation) than a group of control homes.

41151 (ORNL/CON—226) **Cooling energy measurements of single-family houses with attics containing radiant barriers in combination with R-11 and R-30 ceiling insulation.** Levins, W.P.; Karnitz, M.A. (Oak Ridge National Lab., TN (USA)). May 1987. Contract AC05-84OR21400. 85p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87012758.

Oak Ridge National Laboratory continued the testing of radiant barriers in three unoccupied houses near Knoxville, Tennessee, under the joint sponsorship of the Department of Energy and the Tennessee Valley Authority. The prime goal of the work was to determine the effect of the interaction of radiant barriers with different levels of attic insulation on house cooling loads. Both horizontal and truss installations of radiant barriers were used along with R-11 and R-30 fiberglass-batt attic insulation. Previous work had been done at Karns using both types of barriers with R-19. The results of the testing showed that horizontal barriers are more effective than truss barriers. A horizontal radiant barrier in combination with R-11 attic insulation saved 16% compared with R-11 and no barrier. The cooling load reductions with R-30 and a barrier were minimal (2%) compared with R-30 and no barrier. The best performing system was a combination of a horizontal barrier and R-19, which was estimated to reduce the house cooling load by 25.1% when compared with R-11 and no barrier. Differing climates, house styles, configurations and occupancy effects are capable of altering these results.

41152 (ORNL/Sub—79-42539/8) **Heat transfer characteristics of insulated concrete sandwich panel walls: Draft report.** Van Geem, M.G.; Shirley, S.T. (Construction Technology Labs., Skokie, IL (USA); Oak Ridge National Lab., TN (USA)). May 1987. Contract AC05-84OR21400. 217p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE87013344.

Tests were conducted to evaluate thermal performance of three insulated concrete sandwich panel walls. Heat transfer through the walls was measured for steady-state and dynamic temperature conditions. The objective of the test program was to investigate effects of ties connecting wall layers on thermal properties of insulated sandwich panel walls. The three walls tested were similar except for the type of connectors joining the insulation and concrete layers. Each wall consisted of 2-in. (50-mm) of extruded polystyrene insulation board sandwiched between two 3-in. (75-mm) normal weight concrete layers. The first wall, a control wall, contained no ties. Layers of the second wall were connected using stainless steel ties and anchors. Layers of the third wall were connected using high-tensile fiberglass-composite ties. Walls were tested in the calibrated hot box facility (ASTM Designation: C976) at Construction Technology Laboratories, Inc. (CTL). Steady-state tests were used to measure thermal resistance (R/sub T/) and thermal transmittance (U). A comparison of results from steady-state tests on the control wall and the wall with stainless steel connectors showed that stainless steel connectors reduced wall thermal resistance by 7%. A comparison of results from steady-state tests on the control wall and the wall with high-tensile fiberglass-composite ties showed that the ties did not reduce wall thermal resistance. Dynamic calibrated hot box tests provided a measure of thermal response under selected temperature ranges. Heat storage capacities of the walls delayed heat flows through specimens. Average thermal lag values ranged from 5 to 6 hours for the three walls.

41153 (PNL-SA—14864) **Energy efficient new homes programs: Utility experiences.** Callaway, J.W.; Branch, K.R. (Pacific Northwest Lab., Richland, WA (USA); Battelle Human Affairs Research Center, Seattle, WA (USA)). Mar 1987. Contract AC06-76RL01830. 15p. (CONF-870642—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012168.

From 3. national conference on utility DSM programs: demand-side management strategies in transition; Houston, TX, USA (16 Jun 1987).

In 1986, the Bonneville Power Administration and many Pacific Northwest utilities embarked on an unparalleled effort to encourage the construction of new homes in the BPA region that go beyond current levels of space heating energy efficiency. By 1995, regional power plans call for 85% of new, electrically space heated homes to be built to these levels, termed the Model Conservation Standards (MCS) by their proposer, the Northwest Power Planning Council. To assist in the development of utility-sponsored new homes programs in the Northwest, a survey was conducted of utilities that have had practical experience in efforts to increase the efficiency of new homes built in their service areas. This paper discusses the results of that survey.

41154 **Acoustic evaluation of thermal insulation.** Blessing, G.V.; Flynn, D.R. (to Secretary of Commerce, Washington, DC). US Patent 4,672,851. 16 Jun 1987. Filed date 30 May 1986. vp.

A method is described for measuring the density, thickness, and thermal conductivity of an insulation layer in an attic space above a ceiling comprising inserting at least one probe through a small aperture in the ceiling having transducer means thereon for transmitting and receiving acoustical signals. It transmits an acoustic signal from a first transducer through the insulation material to a second transducer and calculates the density, thickness, and thermal conductivity of the insulation by comparing the measurement of the received signal with standard values for the same type of insulation.

41155 **The effect of energy conservation measures on residential electricity demand and load shape.** Ruderman, H.; Levine, M.D.; Chan, P. (Lawrence Berkeley Lab.). pp 8.203-8.216 of Proceedings from the ACEEE 1986 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1986). (CONF-860818—). Contract AC03-76SF00098.

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

The authors have developed a method for calculating changes in annual electricity consumption and hourly loads in the

residential sector resulting from the implementation of one or more energy conservation measures in a utility service area. They used the methodology to evaluate different measures by comparing their impacts in three service areas with differing load characteristics. The measures included improvements to the thermal integrity of the building, increased appliance efficiencies, as well as combinations of these measures. They selected three service areas that differed widely in their climatic conditions, appliance saturations, and other household characteristics. They evaluated the conservation measures by comparing their impacts on electricity sales and on peak summer and winter loads.

41156 **The low income weatherization program: Toward establishing program objectives ten years later.** Hubinger, G. (Minnesota Dept. of Energy and Economic Development). pp 8.118-8.133 of Proceedings from the ACEEE 1986 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1986). (CONF-860818—).

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

Federal and state governments have funded programs to weatherize the homes of low income people since the middle 70's, primarily through the federal Weatherization Assistance Program. Minnesota has invested some $30 million of its own appropriations combined with approximately $68 million in federal funds to weatherize almost 100,000 residences around the state. One apparent--but extremely critical--deficiency has been lack of clearly established objectives for the program. Is the Weatherization Program's goal to reduce the fuel bills for low income people and if so, to what degree? Is it to eliminate or at least significantly reduce reliance on fuel assistance? Is it to invest public funds to a point of positive net present value? Or is it to achieve some common standard of efficiency for all buildings that are improved? Is it to improve as many residences as possible at a more limited level so at least some benefits accrue to all low income households? Or should the focus be on fewer homes improved to ensure greater quality? Or is Federal Weatherization a jobs training program for providing disadvantages individuals with skills that are marketable? This paper begins a discussion of these fundamental questions that lead to very different outcomes in the way the program is administered and in the results that are achieved.

41157 **Residential energy and policy simulation: Accuracy of results from the ORNL residential reference house energy demand model.** Hamblin, D.M. (Battelle Columbus Div.). pp 8.87-8.104 of Proceedings from the ACEEE 1986 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1986). (CONF-860818—).

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

The ORNL Residential Reference House Energy Demand (RRHED) model is a computer-based engineering-economic end-use simulation model which forecasts energy demand and conservation policy impacts based upon a detailed evaluation of how households use energy for particular appliances. The focus of the current study is the revealed accuracy of model predictions in four areas: aggregate electricity sales over a five-year historical period; new structure penetration projections for space and water heat; aggregate space heat energy use per new building; and costs of conserved energy for shell improvements. The geographic area for analysis is the Pacific Northwest area of Bonneville Power Administration service. The RRHED model produces weather adjusted forecasts for historical years. These predictions for Public and Private Rate Pools are compared to actual sales data.

41158 **Using commercial market data for strategic program planning.** Gordon, F.M.; Hickman, C.; Brown, M. (Bonneville Power Administration). pp 8.72-8.86 of Proceedings from the ACEEE 1986 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1986). (CONF-860818—).

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

This paper demonstrates a method for utilizing market data and projections obtained from end use forecasting models to target conservation programs to the consumers. The method assures that the programs both meet the needs of consumers, and encourage conservation actions which would not have taken place without the programs. Economic and end uses analyses are used to estimate the potential long term savings to BPA from 12 building types. Attitudinal studies are then used to show differences in interest in energy conservation among different demographic groups. Demographic studies are used to track the frequency of these factors within each of 12 major commercial building types. The amount of conservation available from each building type is then compared to the degree of interest in conservation among the consumer groups which occupy that building type. This comparison provides an indication of the level of conservation activity which could be expected with and without conservation programs.

41159 **The incentive structure and level for BPA's purchase of energy savings.** Schick, H.; Vinnard, A. (Bonneville Power Administration). pp 8.217-8.219 of Proceedings from the ACEEE 1986 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1986). (CONF-860818—).

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

The Purchase of Energy Savings (PES) is one of several commercial building retrofit activities currently being conducted by the Bonneville Power Adminstration (BPA) in the Pacific Northwest. The incentive structure and level used within this program has been refined over time. In field testing the PES approach, the private entrepreneurs responding to the solicitation requested rather high incentive levels and short payback periods for the commercial buildings to be retrofitted. This indicated that some sponsors were mainly identifying low cost, quick payback conservation measures through their preliminary audits and substituting BPA's payments for the building owner's contribution towards the cost of the job. The BPA incentive was set at a percentage of the cost of each job.

41160 **Bonneville's Conservation Policy Analysis Model.** Bull, M.; Barton, P. (Bonneville Power Administration). pp 8.7-8.20 of Proceedings from the ACEEE 1986 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1986). (CONF-860818—).

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

In 1980 the U.S. Congress mandated that the Bonneville Power Administration use conservation as the first priority resource to meet its load obligations. As Bonneville began to address this challenge, it lacked the tools to easily and accurately analyze the system-wide impacts of the many conservation policy options available to it. In 1983 Bonneville began the development of the Conservation Policy Analysis Model (CPAM). The model features full representation of the major components of the electric power system of the Pacific Northwest and treats conservation programs and policies as simulated market responses by using simplified end use modeling. This paper discusses the important attributes of strategic policy analysis tools for conservation in general along with Bonneville's experience with the CPAM effort. Selected policy analysis results and observations and conclusions on future directions for strategic conservation modeling follow the general discussion.

41161 **Valuation of demand side utility programs.** Kahn, E.; Eto, J.; Koomey, J.; Mc Mahon, J.; Chan, P.; Levine, M. (Lawrence Berkeley Lab.). pp 8.147-8.160 of Proceedings from the ACEEE 1986 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1986). (CONF-860818—).

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

This paper examines large scale demand side programs whose impacts require a change in utility supply plans. The benefits of the programs are defined in terms of the costs or value of power plants expected in service that are deferred by the programs in question. Case studies are developed for standards program that increase the efficiency of residential appliances. The utilities studied are the Nevada Power Company and the Texas Utilities Electric Company. The annual energy and hourly load impacts of these programs are calculated using the LBL Residential Energy and Hourly Demand models calibrated to data for the specific utilities. The Nevada Power cases focuses on determining the optimal deferral period by using production simulation modelling techniques. In the Texas Utilities case we use cost data based on purchase terms offered to cogenerators as the valuation method. In this case the procedures for allocating capacity value are the focus of attention. Two different rules are examined.

41162 **Determinants of household energy efficiency and demand.** Baxter, L.; Feldman, S.; Schinnar, A.; Wirtshafter, R. (California Energy Commission, Sacramento, CA). pp 151-170 of Energy efficiency: Perspectives on individual behavior. Kempton, W.; Neiman, M. Washington, DC; American Council for an Energy Efficient Economy (1986).

This study of household service provision efficiency provides new insights into household energy use. The study described in this paper indicates the importance of several factors not considered or found significant in previous studies. The results indicate that electrically heated homes are more efficient than those heated by natural gas, that those homes with higher ratios of nonelectric to electric fuel inputs are more efficient, and that owner-occupied dwelling are more efficient than rental properties.

41163 **Saving energy the easy way: An analysis of thermostat management.** Vine, E. (Lawrence Berkeley Lab., Berkeley, CA). pp 121-134 of Energy efficiency: Perspectives on individual behavior. Kempton, W.; Neiman, M. Washington, DC; American Council for an Energy Efficient Economy (1986).

The author has analyzed data on self-reported winter and summer thermostat settings and control strategies collected in recent surveys by state and federal energy agencies, utility companies, and by our own group at Lawrence Berkeley Laboratory. He was interested not only in the distribution of thermostat settings but also in the dynamics of thermostat management. Hence he has examined how thermostat behavior was related to the following occupant-related features: socioeconomic characteristics of occupants (age, education, income, home ownership, and race), building characteristics (house, type, size, and age), space conditioning fuel and system, climate, and energy audit programs. He has also examined thermostat management over time (during the day, seasonally, and yearly) and analyzed its relationship to energy use and developed a conceptual model of thermostat management to examine these variables. He has indicated some of the possible relationships between the variables and thermostat management.

41164 **Energy use among the low-income elderly; a closer look.** Diamond, R.C. (Lawrence Berkeley Lab., Berkeley, CA). pp 287-304 of Energy efficiency: Perspectives on individual behavior. Kempton, W.; Neiman, M. Washington, DC; American Council for an Energy Efficient Economy (1986).

The author's study of energy use among the low-income elderly at Winston Gardens continues to perplex and astonish him. He has found that simple indicators such as reported thermostat settings and measured air leakage area are not able to explain the variations in energy use observed in the utility bills. By examining the energy use of individual residents and of categories of high and low energy users, he has identified characteristics of each group that help explain their different usage patterns. Differences in the residents' health and comfort, their level of satisfaction with the heating/cooling system, the degree of understanding and control they exercised, their attitudes toward conserving, and their income and status all appear to be variables underlying the wide divergence in energy usage. A next step will be to use these variables in developing a model that can characterize behavioral effects on energy consumption. Given the authors experience with the data from the residents at Winston Gardens, this will be no small task.

41165 **Evaluating a community based private/public partnership in residential energy conservation.** Morgan, S.J. (Technical Development Corp.). pp 5.142-5.157 of Proceedings from the ACEEE 1986 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1986). (CONF-860818—).

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

This paper presents the results of an evaluation team operated in the context of the following goals set forth by the Maine Office of Energy Resources, which convened the Portland Task Force: to promote the use of and improvement in the RCS audit; to provide hands-on training in the installation of low cost infiltration measures; to stimulate additional purchase of low cost measures by providing a free kit of conservation materials; to generate loans for energy improvements; to coalesce existing program providers in the offering of a more comprehensive and coordinated package of services; and to gain experience in the planning and implementation of a weatherization program. The planning participants requested the evaluation before committing additional resources to an expanded Maine program; DOE was also interested in program model refinements and potential applications in other communities.

41166 **New directions for conservation programs.** Kreitler, V.; Kirchen, S. (Synergic Resources Corp.). pp 5.101-5.113 of Proceedings from the ACEEE 1986 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1986). (CONF-860818—).

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

Thirteen residential conservation programs were selected to serve as case studies in an evaluation of alternatives to the RCs (Residential Conservation Service) program. The findings from that study provided the basis for the discussion in this conference paper and reviews selected program planning approaches currently in use, comparing their benefits and suggesting that there is a need for greater formalization of the planing process. In addition, the need for better understanding of customer acceptance factors is discussed. Some new efforts in the areas of program planning and market research are identified. The discussion concludes with a recommendation that the government and trade associations need to address further program planning and evaluations issues while utilities individually need to adopt a more proactive stance toward their programs and the conservation marketplace.

41167 **Marketing energy efficiency in North Carolina public housing: Lessons learned from field experience.** Gee, P.S.; Aldridge, K. (Alternative Energy Corp. (AEC)). pp 5.75-5.92 of Proceedings from the ACEEE 1986 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1986). (CONF-860818—).

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

This paper discusses the North Carolina Alternative Energy Corporation's (AEC) experience in developing a comprehensive program to improve energy efficiency in public housing, especially the smaller all-electric authorities. Elements of that program include: creating incentives to motivate public housing administrators to pursue energy efficiency; comparing alternative strategies for achieving energy efficiency in multi-family housing; demonstrating creative multi-participant financing options to fund energy improvements; developing effective ways for smaller PHAs to implement energy improvements; and analyzing results to provide PHAs with feedback on energy efficiency efforts for multi-family housing.

41168 **Understanding the market for conservation technologies in the commercial sector.** Dinan, T.M. (Oak Ridge National Lab.). pp 5.37-5.49 of Proceedings from the ACEEE 1986 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1986). (CONF-860818—).

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

The purpose of this paper is to further the understanding of the decision process associated with conservation retrofit investments in the commercial sector. It includes a discussion on: the stages involved in a decision to undertake conservation retrofit activities; the participants that might be involved in such decisions; the decision criteria utilized by different types of organizations; barriers to implementing conservation; and the impact that the attributes of conservation investments might have on the decision outcome. Based on the findings of this report, a five-step plan is recommended for improving the effectiveness of policies designed to promoted conservation in the commercial sector. This plan involves: segmenting the commercial sector; identifying the barriers and decision criteria associated with each market segment; targeting policies; linking market segments with appropriate technologies. Each conservation investment is ranked according to eight product attributes on a market segment specific basis; and utilizing a flexible approach.

41169 **Participation of the elderly in utility-sponsored residential conservation programs.** Berry, L.G.; Brown, M.A. (Oak Ridge National Lab.). pp 5.5-5.19 of Proceedings from the ACEEE 1986 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1986). (CONF-860818—). Contract AC05-84OR21400.

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

Although greater-than-average opportunities for residential energy efficiency improvements exist among the elderly, most utility-operated conservation programs are not successful in reaching this subgroup. This paper reviews research on elderly participation in utility programs. It contains a literature review, descriptions of program participation levels among the elderly, and a discussion of discrete choice model results which show that the association between age and nonparticipation persists even after the effects of other predictors such as income, education, dwelling age and need for retrofit are removed.

41170 **An analysis of lifestyle effects on residential energy use.** Stovall, T.K. (Oak Ridge National Lab.). pp 7.246-7.258 of Proceedings from the ACEEE 1986 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1986). (CONF-860818—). Contract AC05-84OR21400.

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

This study also represents results from an examination of data from the Hood River Conservation Project. This data represents 320 homes were submetered energy use and indoor temperature data is also available on a 15 minute basis. The extensive surveys included in this project address a large number of lifestyle effects. However, because this analysis is still in progress, the results presented here are preliminary and far from complete. Indoor temperature and heating and air conditioning energy use were examined with respect to outdoor temperature, heating system type, family size, house size, and house type. Hot water energy use was similarly examined. Several trends associated with these variables were identified: homes with central thermostats are more likely to use a nighttime temperature setback during the winter than those with individual room controllers; outdoor temperature affects thermostat management during the winter; and hot water use varies seasonally with the variation being most noticeable during the fall months.

41171 **Exploratory analysis of residential end-use consumption.** Stokes, G.M.; Miller, N.E. (Pacific Northwest Lab.). pp 7.230-7.245 of Proceedings from the ACEEE 1986 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1986). (CONF-860818—).

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

This paper presents data collected as part of the Bonneville Power Administration's End-use Load and Conservation Assessment Program (ELCAP) include highly disaggregated residential data taken with hourly integration periods. The detailed end-use patterns seen in this data offer the opportunity to explore occupancy effects in residential energy consumption to an unprecedented degree. Preliminary analyses have suggested that aggregations of data according to similar consumption profiles, an actively-based end-use aggregation scheme, provide an interesting complement to analyses based on simple equipment-based analyses. An earlier analysis of this data was based on a series of multivariate statistical techniques including multidimensional scaling and principal component analysis. In this paper the analyses are continued and a series of waveform classification schemes are used to establish a firm basis for comparing energy consumption profiles between residences.

41172 **Are we fighting a battle we've already won? A dynamic regression analysis of 17 years of electrical billing data to determine residential household usage trends.** Khawaja, M.; Schoch, K.; Peach, H.G. (Pacific Power and Light Co.). pp 7.207-7.224 of Proceedings from the ACEEE 1986 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1986). (CONF-860818—).

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

This paper is a study of trends of electricity consumption in homes with installed electric heating equipment in three Oregon communities. The analysis presented investigates the effect of various economic factors on monthly kwh usage after the effect of weather is removed. Weather normalized billing data from 1968 to 1985 is analyzed. Factors investigated include previous month's usage, real average price, per capita income, number of home energy audits, type of rate structure, and percent of multi-family dwellings. Results show that residential customers have voluntarily curtailed their electricity consumption since approximately 1977. The impact of this reduction in consumption on potential energy savings is discussed as it relates to residential weatherization projects.

41173 **Profile of a nonparticipant.** Kaplon, S.; Engels, D. (Pacific Power and Light Co.). pp 7.119-7.133 of Proceedings from the ACEEE 1986 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1986). (CONF-860818—).

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

This study identifies and profiles those individuals against participation in the Hood River Conservation Project when economic barriers were virtually absent and the community was mobilized to support weatherization. Three types of nonparticipants are categorized: customers who had no contact with the project; customers who contacted the project, yet refused the home energy audit; and customers who received a home energy audit but refused weatherization. All electric homes were eligible for project weatherization. In order to develop a profile on these individuals a telephone survey was administered to all eligible nonparticipants in the study area. Demographics, attitudinal characteristics, and kilowatthour energy data of the nonparticipants were analyzed. A direct comparison was then made between nonparticipants and participants. This profile of Hood River nonparticipants will enable conservation planners to develop a better understanding of what motivates individuals not to participate in weatherization programs and to use this information in future program planning and research.

41174 **Heating a multifamily building: Tenant perceptions and behavior.** De Cicco, J.M.; Kempton, W. (Center for Energy and Environmental Studies, Princeton Univ.). pp 7.47-7.61 of Proceedings from the ACEEE 1986 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1986). (CONF-860818—).

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

This paper discusses tenant perceptions and behavior regarding heating and ventilation in a multifamily building. Data were collected at Lumley Homes, a 60-unit subsidized housing complex for senior citizens in New Jersey. The building has a central gas boiler which supplies steam to radiators throughout the building; gas is neither metered nor billed to individual apartments. The heating system is centrally controlled by a boiler operator. In the apartments, tenants can control the valves on each radiator. Residents often report that they have too much heat in the winter and many windows are open even on the coldest days. Two types of data are used: ethnographic interviews and a questionnaire survey of all the residents. We give quantitative measures of reported comfort and strategies for controlling comfort. We also qualitatively discuss the factors which tenants consider to be important for thermal comfort in the apartments and their reasons for using various control strategies. For example, if a resident is too hot in the winter, he or she may open the window, close the radiator valve, or complain to management. Survey data are used to quantify the choices tenants say they make and the ethnographic data are used to examine the factors involved in making their choices among the various options for comfort control.

41175 **Performance of the Princeton Scorekeeping Method for estimating annual end-use energy shares as measured with metered end-use load data.** Westman, E.D.; Monroe, W.H. (Bonneville Power Administration). pp 9.326-9.339 of Proceedings from the ACEEE 1986 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1986). (CONF-860818—).

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

This paper reports the results of an evaluation of PRISM's performance at estimating space heating and baseload energy consumption in 40 Pacific Northwest residential households located in Albany and Bend, Oregon. Metered end-use data for an entire year, beginning in April 1983, was used to represent utility billing data in regression models of the specification found in PRISM. Regressions were estimated for each of the 40 households using metered total energy data and local NOAA weather station data. The results of these linear regressions were then compared with the metered end-use data for space heating and baseload end uses. Comparisons were made using a variety of statistical measures. Correlation coefficients for percent errors in PRISM end-use estimates and model inputs and parameters were investigated. Regression residuals were analyzed for behavior of error components, and survey-based characteristics data were used to explore for differences in PRISM's performance distinguishable through dwelling, occupant, and geographic characteristics. Finally, a discussion of the implications of these findings was made with respect to the current uses of PRISM for energy conservation assessment and evaluation.

41176 **Predicting energy use - Influence of the recording interval.** Sharp, T.R. (Oak Ridge National Lab., Oak Ridge, TN). pp 9.274-9.285 of Proceedings from the ACEEE 1986 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1986). (CONF-860818—). Contract AC05-84OR21400.

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

This paper discusses a study that showed that the recording interval has considerable influence on the heating energy use rate (slope) and the base temperature resulting from a regression model used to model heating energy use. Fifteen-minute space heating energy use data recorded for four electrically-heated homes in the Minneapolis, Minnesota, area between Jan. 1 and April 30, 1982 were used in the study. The data were aggregated to create the data sets needed to examine the effects of changes in the recording interval on model parameters. An increase in the recording interval increased the slope of the regression model and decreased the predicted base temperature of the building. In predicting annual space heating energy use in a typical meteorological year (TMY), the compensatory changes that occurred in the slope and base temperature were not sufficient to prevent significant differences. The variation was 1-7% for the 4 houses studied.

41177 **Energy management systems as a source of building energy performance data.** Le Coniac, P.; Flora, D.; Akbari, H. (Buildings Energy Data Group, Lawrence Berkeley Lab., Univ. of California, Berkeley, CA 94720). pp 9.170-9.185 of Proceedings from the ACEEE 1986 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1986). (CONF-860818—). Contract AC03-76SF00098.

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

The authors observe that energy performance of buildings is often estimated by computer simulation but it must also be verified with actual measured data. One of the techniques used to collect these data exploits existing in-place Energy Management Systems (EMSs). Compilation and analyses of hourly energy use, weather, and occupancy information recorded by EMSs can provide a quick and cheap method of obtaining an electrical energy end-use breakdown without actually submetering end-uses such as lighting, heating, and cooling. The capabilities of existing EMSs as a key to end-use characterization of an industrial/commercial building in Milpitas, California, have been evaluated. Spreadsheets break down the daily and hourly total building electricity use into their major end-use constituents. The calculated total building electricity use agrees with measured data fairly well (within 10%) for the daytime hours of building operation where schedules and occupancy are known. It is concluded that gathering information with even simple EMSs can be a useful, logical, and relatively inexpensive step toward understanding present energy use and revealing areas of load management and conservation.

41178 **A microcomputer algorithm for degree-days to an arbitrary base.** Holt, D. (U.S. Dept. of Energy). pp 9.146-9.154 of Proceedings from the ACEEE 1986 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1986). (CONF-860818—).

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

For energy-efficient buildings, many analysts need estimates of annual heating degree-days measured from a base temperature different than the conventional 65°F. This paper presents an algorithm to estimate annual heating degree days (AHDD) from an arbitrary base temperature. The algorithm may be used with a pocket calculator, or may be incorporated in microcomputer modeling programs that analyze energy use in buildings. It is based on a physical climate model with two parameters: the annual average temperature, and the average temperature of the coldest month. Algorithm results are compared to degree-day data published by the Los Alamos National Laboratory (LANL) for every state in the United States and for four base temperatures. The average difference between algorithm estimates and LANL data is 15 AHDD, with a standard deviation of 168 AHDD. This standard deviation is about half the standard deviation of year-to-year fluctuations in AHDD in most parts of the United States. The correlation coefficient between algorithm data and the comparison data is 0.998 over the range 0 - 20,000 AHDD, and 0 - 6000 annual cooling degree days.

41179 **Multivariate statistical assessment of meteorological influences on residential space heating.** Hadley, D.L.; Tomich, S.D. (Pacific Northwest Lab.). pp 9.132-9.145 of Proceedings from the ACEEE 1986 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1986). (CONF-860818—).

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

The relationship between residential space heating in four residences in the Pacific Northwest and the external meteorological determinants of the space heating variability were investigated using the statistical techniques of principal component analysis (PCA) and multivariate regression analysis. The PCA identified 3 significant, uncorrelated components that were linear combinations of the 6 original meteorological variables. The first component, dominated by the outdoor temperature, accounted for between 65% and 69% of the variability in the original meteorological data and explained between 55% and 85% of the variability in the daily total space heating consumption. The first three principal components combined to explain over 95% of the variability in the data and up to 90% of the variability in the space heating.

41180 **Taking PRISM one step further: The refraction method to decompose energy savings.** Goldberg, M.L.; Fels, M.F. (U.S. Energy Information Administration). pp 9.115-9.128 of Proceedings from the ACEEE 1986 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1986). (CONF-860818—).

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

The authors present a simple "refraction" method developed to extract energy conservation trends from energy billing data. With this methodology, energy savings estimated by the Princeton Scorekeeping Method (PRISM) are decomposed into physically meaningful components. In addition, indoor temperature changes are inferred, and the effect of such changes on energy savings is quantified. The method is demonstrated in two test applications. The first, to individual-house billing data for a large number of gas-heated houses in Wisconsin, suggests the dominant role of structural retrofitting in the energy savings achieved by a low-income weatherization program. The second application, to utility aggregate data for nearly one million gas-heated houses in New Jersey, points to the importance of lower thermostat settings in the years immediately following the oil embargo, and, since 1980, to a substantial decline in consumption by appliances including water heaters. More recently, the role of structural retrofitting seems to be increasing, but a "takeback" effect due to a concomitant increases in indoor temperatures may be eroding the resulting savings.

41181 **PRISM research: Yesterday, today, and tomorrow.** Fels, M.F.; Hurvich, C.M.; Reynolds, C.L. (Center for Energy and Environmental Studies, Princeton Univ.). pp 9.106-9.114 of Proceedings from the ACEEE 1986 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1986). (CONF-860818—).

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

The authors discuss PRISM, the Princeton Scorekeeping Method, is a statistical procedure which uses available data to monitor energy conservation in housing. The PRISM software has been used for the measurement of energy savings in a wide variety of energy conservation programs, involving use of all major fuels for heating, in multifamily as well as single-family buildings, over a wide range of heating-dominated climates in the U.S., and for aggregate as well as individual-building consumption. Applications to date, by Princeton and by other scorekeeping groups, are summarized. In addition, current and future directions for PRISM research are identified in the context of anticipated applications.

41182 **Instrumented buildings: Experiences in obtaining accurate data.** De Cicco, J.; Mc Garity, A.; Norford, L.; Ryan, L. (Center for Energy and Environmental Studies, Princeton Univ.). pp 9.75-9.87 of Proceedings from the ACEEE 1986 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1986). (CONF-860818—).

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

In this paper some of the pitfalls encountered in the course of monitoring buildings are discussed. The problems have included: electrical storm damage to a hardwired, distributed-intelligence data acquisition system; thermal instability and limited resolution of solid-state temperature measurement electronics; troubles with pulse counters for gas and electric meters; difficulties in placement and calibration of flow meters. Ways of dealing with such problems are: criteria for selection, redundance, and placement of sensors; calibration procedures; data cross-checking; quick-look plotting and tabulation of data. Many quality assurance techniques have been embodied in software we developed for acquisition, archival, extraction, and preliminary analysis of the data from our buildings. This paper highlights experiences in monitoring buildings to benefit others as well as suggestions and related experiences in building's energy conservation research.

41183 **Energy use in the enerplex office buildings: A progress report.** Norford, L.; Rabl, A.; Ryan, L.; Spadaro, J.; Socolow, R. (Center for Energy and Environmental Studies, Princeton Univ.). pp 3.146-3.159 of Proceedings from the ACEEE 1986 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1986). (CONF-860818—).

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

A full year of energy-use data is now available for two new, heavily instrumented office buildings which incorporate a variety of technologies designed to reduce energy consumption. The authors present monthly, disaggregated energy use in both buildings. One building, fully occupied, has exceeded its target energy budget by a factor of three, due to unanticipated and large electricity use by computers and a cafeteria; the need to remove the heat generated by this equipment and the inability to use the heat in winter; a failure to take advantage of the daylighting features designed in the building envelope; and limitations in the design and operation of the HVAC controls. Their study of the heat pumps and ventilation system in the other, partially occupied building has pinpointed fan and heat pump performance which is both somewhat less than predicted and difficult for the building superintendent to detect. They identify modifications the superintendent has made to the controls, in some cases reducing energy use and in others, particularly in overriding night setback, greatly increasing energy use. The superintendent's need for more information in adjusting the controls is highlighted.

41184 **Energy edge buildings in Oregon.** Perry, J. (Oregon Dept. of Energy). pp 3.173-3.175 of Proceedings from the ACEEE 1986 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1986). (CONF-860818—).

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

Energy Edge is a project of the Bonneville Power Administration (BPA). It is being administered by four Sponsors. ODOE is the sponsor for Oregon outside the Portland area. Energy Edge is one of a number of actions mandated by the Northwest Power Planing Council in their regional energy plan. The Energy Edge Project is run as a competition. The buildings will be selected based on the merits of their design and the costs of their energy conservation measures. To date, two projects have preliminary approval from ODOE. These buildings are in a early stage of design and energy analysis. Detailed information and analysis of the buildings will be given at the presentation of this paper. Sponsors were surprised to find how easy it was in many case to reach the energy

saving goal. Often one or two very modest measures were enough. This was particularly true for smaller, more skin-dominated buildings. This finding supported the Council's belief that additional cost effective savings can be found beyond the MCS.

41185 **A comparison of measured end-use consumption for twelve energy-efficient, new commercial buildings.** Piette, M.A. (Lawrence Berkeley Lab.). pp 3.176-3.192 of Proceedings from the ACEEE 1986 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1986). (CONF-860818—). Contract AC03-76SF00098.

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

Assessment of the energy efficiency of commercial buildings is greatly enhanced by using energy consumption data that is more detailed than whole-building utility bills. The author has compiled and analyzed measured end-use data for 12 new, energy-efficient commercial buildings from the BECA-CN data base. Data sources include federally funded energy-efficient building research programs and utility demonstration projects. Energy use data, broken down into lighting, cooling, heating, fans and pumps, and miscellaneous, are available for eight of the buildings. Data analysis consists of defining and comparing monthly and annual end-uses among the 12 buildings. When making comparisons among the buildings the author considers differences in: miscellaneous equipment loads, occupancy patterns, and weather. Seasonal variations of end uses are discussed. Heating and cooling energy use appears to be correlated with average monthly outdoor temperature for most of the buildings. Lighting energy use tends to be higher in the winter than in the summer. He also compares the measured data to simulation data from ASHRAE Standard 90 research.

41186 **Energy conservation opportunities in commercial buildings - Training and services for improved o/m.** Kolb, J.O. (Oak Ridge National Lab.). pp 3.103-3.105 of Proceedings from the ACEEE 1986 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1986). (CONF-860818—).

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

The implementation of proper O/M procedures in commercial buildings has been recognized as not only cost-effective, but also as an essential prelude to additional and more costly conservation retrofit actions. This study had the following major objectives: to determine the scope and nature of resources of O/M training and services for commercial building HVAC systems; to determine the types of barriers that prevent or reduce the application of appropriate O/M procedures; to assess the potential for increased penetration of O/M services in the commercial building sector; and to propose efforts that integrate and leverage program elements of the DOE commercial Building Energy Retrofit research program with private sector initiatives. The primary approach used in this study was to use telephone interviews of various organizations considered to be representative of the particular segment of the private sector involved in commercial building O/M retrofit activities.

41187 **Overview of the energy edge project design upgrading efficiency in commercial construction practice.** Miller, K. (Bonneville Power Administration). pp 3.130-3.132 of Proceedings from the ACEEE 1986 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1986). (CONF-860818—).

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

The Bonneville Power Administration (Bonneville) is conducting a research project entitled the Energy Edge. Limited information is available on the economic value of designing and constructing commercial buildings which exceed code requirements. The purpose of the Energy Edge is to identify design strategies which are successful in meeting the targeted energy budget at a reasonable cost. Applicants to the competition are given extensive design assistance. Energy modeling, using hourly simulations, identifies the optional combination of efficiency features. The incentive request is based on the participants bid to cover extra design and construction work. Some building owners are willing to cost share. Actual costs of design and construction are collected. Cost information will be correlated to building design performance (predicted and actual).

41188 **A research plan for commercial sector retrofits.** Mac Donald, J.M. (Oak Ridge National Lab.). pp 3.106-3.114 of Proceedings from the ACEEE 1986 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1986). (CONF-860818—). Contract AC05-84OR21400.

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

A plan for a Retrofit Research program at the Department of Energy covering commercial buildings was developed in 1985. The purpose of the plan was to define whether a Federal role was justified for retrofit research and, if so, what work should the program cover. A national panel of experts on energy in buildings and building retrofits was assembled to develop a sense of whether a Federal role was justified and to formulate recommendations for the planned program. The panel stated that a Federal role would be beneficial if the research met the needs of users. The research recommendations of the panel formed a key part of the coverage of the resulting program. With the limited Federal resources available, research is presently conducted in only 6 of the 10 selected areas. Standardization of procedures for evaluating the energy performance of retrofits is emerging as the most important area for the program.

41189 **Energy savings in retrofitted multi-family buildings: New results from the Beca-B Project.** Goldman, C.A.; Greely, K.M. (Lawrence Berkeley Lab.). pp 3.77-3.90 of Proceedings from the ACEEE 1986 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1986). (CONF-860818—). Contract AC03-76SF00098.

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

The authors compile and analyze measured data on 141 retrofit projects in U.S. and Swedish existing multi-family buildings. They examine the costs of conservation measures and practices and the savings they generate. They also discuss the correlation between energy savings and initial pre-retrofit energy intensity, amount of investment, and choice of measures. Various HVAC system retrofits (heating controls, equipment measures, and altered operation and maintenance practices) are the most popular conservation strategies in their sample of buildings. Most buildings in the data base are small to medium size multi-family buildings; 60 percent are between 10 and 50 units; only 10 percent are more than 100 units. They found that categorizing each retrofit project by strategy helped explain much of the variation in the amount invested; however, energy savings still varied widely among similar groups. Preliminary results for buildings in the data base suggest that some envelope measures (e.g., "shell" packages and window measures) have longer payback periods (12 and 16 years, respectively) than many of the heating system retrofit strategies (1-3 years). The authors also report on individual conservation measures that are particularly effective in specific building and heating system types (e.g., outdoor resets for cold-climate buildings with hydronic boilers).

41190 **The Minnesota energy efficient house research project.** Nelson, B.D.; Robinson, D.A.; Nelson, G.D.; Hutchinson, M. (Minnesota Dept. of Energy and Economic Development). pp 2.204-2.206 of Proceedings from the ACEEE 1986 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1986). (CONF-860818—).

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

This research project was conducted from October 1983 to June 1985 to identify factors affecting the energy performance of energy efficient houses in Minnesota. The houses used for this study were built in 1980 under an Energy Efficient Housing Demonstration Program conducted by the Minnesota Housing Finance Agency. This program provided 144 detached and attached housing units throughout the State constructed by 23 different builders. A final report describing this work is available.

41191 **Results of construction quality inspections of 25 low-energy Minnesota homes.** Nelson, G.D. (The Energy Conservatory). pp 2.207-2.209 of Proceedings from the ACEEE 1986 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1986). (CONF-860818—).

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

This paper summarizes a more detailed presentation given at the Santa Cruz Summer Study, August 1986. The many photographs, thermograms, graphs, and tables presented there are omitted here for brevity. However, this and other material will soon be available from NTIS (ORNL/SUB/83-47980/1) in an Oak Ridge National Laboratory report titled Energy Efficient House Research Project Final Report. For this study, the author performed detailed, 2 person-day, highly-instrumented inspections of 25 of the original 144 houses. Instrumentation included a blower door, infrared scanner, wood moisture meter, sling psychrometer, flue gas testing equipment, and digital thermometers. The author completed all inspections during the heating season. The purpose was to document construction quality problems that would affect the energy performance of energy efficient houses.

41192 **Cross-comparisons of new energy-efficient houses.** Busch, J.F.; Goldman, C.A. (Energy Analysis Program, Lawrence Berkeley Lab., Univ. of California, Berkeley, CA 94720). pp 2.27-2.30 of Proceedings from the ACEEE 1986 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1986). (CONF-860818—). Contract AC03-76SF00098.

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

The authors have compiled energy performance data on 431 low-energy homes in the U.S., Canada, and Europe as part of the Buildings Energy-Use Compilation and Analysis project (BECA-A). Measured data on the actual performance of occupied buildings provide an essential form of feedback to architects and builders on how well calculations and computer models actually predict energy performance and dollar savings. Such data need to be systematically collected and compared in a meaningful way. However, differences in weather, operating characteristics, and measurement techniques complicate the process of making performance comparisons among houses. In this summary, we present preliminary results based on an analysis of the heating performance of homes in the data base. They gathered information on building physical characteristics, energy-related behavior of occupants, energy consumption for heating and other end uses, actual and normal-year weather, and the incremental construction costs associated with conservation design features. Results reported in this study are based on a selected sample of 343 homes. For analysis purposes, they categorized each home into one of four broad groups by primary conservation strategy, based on a review of its design features: superinsulated, passive solar, active solar, and earth-sheltered. Seventy percent of the 343 homes are classified as superinsulated. The authors have relatively few examples in the data base of well-monitored active solar and earth-sheltered homes.

41193 **Energy-efficiency choice in the purchase of residential appliances.** Ruderman, H.; Levine, M.; Mc Mahon, J. (Lawrence Berkeley Lab., Berkeley, CA). pp 41-50 of Energy efficiency: Perspectives on individual behavior. Kempton, W.; Neiman, M. Washington, DC; American Council for an Energy Efficient Economy (1986).

Ruderman, Levine and McMahon perform an innovative analysis of a truly impressive amount of appliance data. They infer the consumer's willingness to purchase higher-priced appliances in return for lower future operating costs. Without taking a stand on how consumers actually make purchase decisions, they attempt to measure the "aggregate market discount rate." This rate characterizes the overall operation of the market, including purchase by third parties, such as plumbers or home builders. In a sense, this rate measures the efficiency of the economy as a whole. While it may not measure the process of any individual's decision, it is useful for Ruderman et al.'s purpose-to evaluate the effect that appliance standards might have on the presently unfettered free market.

41194 **Cold facts. Hot ideas. BPA appliance efficiency promotion campaign.** Vincent, G.W.; Gard, B. (Bonneville Power Administration). pp 5.163-5.165 of Proceedings from the ACEEE 1986 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1986). (CONF-860818—).

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

The Bonneville Power Administration (BPA) began implementing its regionwide "Cold facts. Hot ideas." campaign in February 1986. The campaign promotes energy efficiency to consumers who are planning to buy new major appliances. The campaign goal is to increase the "market share" of energy-efficient models in the Pacific Northwest. Phase I of the campaign (general consumer awareness) ran from February to June 1986. Phase II (targeting refrigerators and freezers) ran from July to October 1986. The purpose of this summary and presentation at the 1986 ACEEE Summer Study is to describe the design, implementation, and evaluation of the "Cold facts. Hot ideas." campaign. the authors demonstrate the large role market research has played in the design of the campaign.

41195 **Building as a dynamic calorimeter: Determination of heating system efficiency.** Subbarao, K.; Burch, J.; Jeon, H. (Solar Energy Research Institute). pp 9.288-9.300 of Proceedings from the ACEEE 1986 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1986). (CONF-860818—).

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

In this article, whole building calorimetry is used to determine the efficiency of a residential forced air gas heating system, before and after retrofitting the system. After calibration, the heating system to the house was turned on and observed for several days. Heating system efficiency is obtained by integrating the heat flows over some interval and dividing by the measured total gas input. This efficiency is the net result of combustion losses as well as distribution system losses to the unconditioned basement. For the furnace tested, initial efficiency was 52 +- 2%. After the system was retrofitted (mainly increasing the fan flow rate and taping some duct leaks), the efficiency increased to 58 +- 2%. Building calorimetry has implications far beyond the measurement technique demonstrated in this paper. One related application of interest is on-line diagnosis of HVAC systems, based upon measurements typically available to an energy management system.

41196 **Evaluation of integrated lighting system performance in a large daylighted office building.** Warren, M.; Benton, C.; Verderber, R.; Morse, O.; Selkowitz, S.; Jewell, J. (Lawrence Berkeley Lab.). pp 3.218-3.231 of Proceedings from the ACEEE 1986 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1986). (CONF-860818—). Contract AC03-76SF00098.

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

The use of daylight for ambient illumination can substantially reduce the energy usage if the electric lighting system is properly controlled in response to available daylight. This paper evaluates the monitored performance of an integrated lighting system in a recently completed 56,000-m/sup 2/ office structure in the San Fran-

cisco Bay Area. Natural light serves 3,000 employees in open-plan offices throughout the five-story building. The architectural scheme includes: ceilings that slope from 4.25 m high at the perimeter to 2.75 m at the center; 3.5-m light shelves at the exterior walls; and a central atrium providing light to the interior spaces. The electric lighting system consists of fluorescent fixtures with continuously dimming ballasts controlled by photocells, which supplement available daylight when necessary.

41197 **Measured performance of cool storage in buildings: Summary of initial analysis.** Wyatt, E.; De la Moriniere, O. (Buildings Energy Data Group, Lawrence Berkeley Lab.). pp 3.248-3.250 of Proceedings from the ACEEE 1986 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1986). (CONF-860818—).

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

In the past several years, utilities and state agencies throughout the country have sponsored a large number of programs and incentives to encourage better energy efficiency in buildings. Some recent efforts have been made in the area of peak demand savings, and thermal energy storage has been one of these load management techniques that have garnered a lot of attention. However, most of the analysis of thermal storage system performance has been done with predictions and simulation, generally in the design stage. Our intention has been to compile and analyze measured data on the performance and costs of cool storage systems installed in commercial buildings. The authors study began with the concept that the quality of analysis increases with the level of data available for each building. For a thorough study, they have stressed the importance of submetered data on the cooling system itself - electricity, demand and flow meters. In addition to energy use and peak demand (with descriptive and operational conditions), compressor efficiency and hourly load profiles on the peak cooling day are also desirable pieces of information to have. They began contacting about two dozen buildings known to contain cool storage systems, and requesting the type of data just described. From the current level of analysis, three major points can be drawn: although readily available, whole building data are insufficient to adequately study the operation of a particular system within a building, a thoughtful combination of indicators is necessary to evaluate actual thermal storage performance, and several years of data should be examined, as systems tend to significantly improve over the first few years of operation. The authors will now briefly illustrate each of these points.

41198 **Results of detailed monitoring of one of the energy resource center's multifamily shared savings buildings.** Nelson, G.D. (The Energy Conservatory). pp 2.210-2.212 of Proceedings from the ACEEE 1986 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1986). (CONF-860818—).

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

The St. Paul Energy Resource Center, thru its multifamily shared savings program, has installed small, high-efficiency boilers to operate with existing larger, less efficient boilers in St. Paul apartment buildings. Domestic hot water (DHW) heating is also usually provided by the new boiler. These new boilers, known as "front-end" or "base-load" boilers, have been installed as part of a larger package of retrofits, making it impossible to evaluate their energy savings. This paper reports a study undertaken to determine the operating characteristics and to isolate the energy savings for a base-load boiler at 894 St. Clair in St. Paul. Energy savings for both DHW and space heating and DHW are presented, as well as the efficiencies of the new and old DHW heating systems, and DHW use characteristics of the building.

41199 **Domestic hot water service in Lumley homes: A comparison of energy audit diagnosis with instrumented analysis.** De Cicco, J.M.; Dutt, G.S. (Center for Energy and Environmental Studies, Princeton Univ.). pp 2.33-2.46 of Proceedings from the ACEEE 1986 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1986). (CONF-860818—).

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

Thermal and volumetric domestic hot water (DHW) loads were estimated indirectly based on gas meter billing data, indicating possible system inefficiency in meeting end-use needs. Consumption was then broken down into estimates of the service load supplied plus various loss components using procedures such as those available to a walk-in energy auditor. Next, intensive microcomputer-recorded measurements of water flows and temperatures in the system were sued to refine and validate the audit-based diagnoses. The diagnostic techniques were successfully applied in estimating the major heat loss components in the water heating system. The largest components were the boiler on- and off-cycle losses (especially for the large winter boiler), and heat losses from the distribution system. The DHW efficiencies estimated were relatively low - around 20% in the summer, rising to 30% or more in the winter when the boiler also provides space heat, if boiler losses are charged to the space heating system. The elimination of the steam leak as part of the recent renovation should halve the summertime gas use for water heating. Additional savings are possible through improved control of the hot war distribution pump, e.g. by reduced nighttime circulation. Spectacular savings are possible in new apartment buildings by specifying shorter runs and insulation for hot water piping.

41200 **Conversion from central to apartment-level heating in multifamily buildings: The Asbury Park Village case study.** Dutt, G.S.; Linteris, G.T.; Englander, S.L. (Center for Energy and Environmental Studies, Princeton Univ.). pp 2.59-2.74 of Proceedings from the ACEEE 1986 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1986). (CONF-860818—).

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

Asbury Park Village is a 126-unit public housing project in Asbury Park, New Jersey. This twelve-building complex was heated by a central gas-fired space and water heating system until 1983, when the central system was replaced by atmospheric gas-fired furnaces and water heaters located in each apartment. The low efficiency of the old heating and hot water system appears to be the result of leakage from the distribution network, poor apartment temperature control, and possibly faulty steam trap or high off-cycle boiler losses. Conduction losses from distribution piping and condensate leaks could not have accounted for the poor efficiency. A comparison with alternative high-efficiency decentralized heating options indicates that fuel savings could have been about 65% with comparable payback periods. Of the alternatives, a somewhat novel approach involving three direct-vent space heaters and a high-efficiency water heater per apartment appears to be particularly attractive.

41201 **Passive solar in the United States: 1976-1986.** Balcomb, J.D. (Los Alamos National Lab., Los Alamos, NM 87545). *Passive Solar Journal;* **3**: No. 4, 333-348(1986).

A decade of experience in passive solar development in the United States is reviewed. The evolution of the program through its peak in 1980 to the present is described. Methods of performance prediction and evaluation are discussed including analysis methods, design tools, test modules, and monitored buildings. Results of the monitoring show excellent performance, generally in agreement with the analysis. Passive practice is analyzed and problems are discussed. The current research program is described and potential savings are estimated.

41202 **Superinsulated houses: The importance of resale value.** Holt, D. (US D.O.E., Washington, DC). pp 93-100 of Energy efficiency: Perspectives on individual behavior. Kempton, W.; Neiman, M. Washington, DC; American Council for an Energy Efficient Economy (1986).

Using three cases that vary in level of superinsulation investment, all of which are highly economic in the long run, Holt shows that energy investments benefit a buyer only if she holds the house more than four years, or, in the case of the most complete insulation package, more than twelve years. Since such investment does benefit the entire sequence of buyers-as well as the society as a whole-the resale value problem represents a public goods challenge to policy makers.

41203 **Home weatherization and indoor air pollutants the Bonneville Power Administration's preferred alternative: Informed consumer choice.** Piper, M. (Bonneville Power Administration). pp 7.201-7.203 of Proceedings from the ACEEE 1986 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1986). (CONF-860818—).

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

In October 1984, the Bonneville Power Administration (Bonneville) began offering free radon monitoring to participants of its regionwide Residential Weatherization Program. The purpose of the radon monitoring is to provide information to participating homeowners or consumers on the average radon concentrations within their residences. This radon concentration information and other information on indoor air quality (IAQ) provided homeowners decision assistance to install "house-tightening" weatherization measures. The mitigation strategy adopted by Bonneville includes the following elements: program participants are given information on indoor air pollutant sources and practical steps for reducing concentrations; participants are provided the option of free radon monitoring prior to or after the installation of house-tightening measures; and Bonneville will assist in the payment for the installation of air-to-air heat exchangers (AAHX) in homes which exceed Bonneville's action level of 5 picoCuries/liter (pCi/l). The AAHX are sized to mitigate only the estimated incremental increase of radon concentration due to the specific house-tightening measures installed. Bonneville's decision to adopt an action level of 5 pCi/l is an attempt to provide of the public welfare, while at the same time allowing the agency to pursue its energy conservation goals. The action level balances the estimated health effects against the cost and benefits of weatherization and mitigation.

41204 **Technical and practical problems of developing and implementing an improved retrofit audit.** Mc Cold, L.N.; Schlegel, J.A.; Hewitt, D.C. (Oak Ridge National Lab.). pp 7.146-7.159 of Proceedings from the ACEEE 1986 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1986). (CONF-860818—). Contract AC05-84OR21400.

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

Oak Ridge National Laboratory developed a retrofit audit suitable for use in the Low-Income Weatherization Assistance Program. The audit selects the most cost-effective retrofits from among about a dozen building shell and heating system retrofits. The audit was field tested this past winter on 35 single-family houses in Wisconsin. This paper describes the important technical problems encountered in developing and implementing an accurate audit. Two types of technical problems were observed. The first type is that the best models available for determining the energy savings of some retrofits produce unreliable results. The second technical problem was related to the audit data; some of the data needed to make accurate energy savings estimates were difficult to obtain or were dependent on auditor judgement. The practical problems included policy or equity questions and difficulties encountered in implementing the audit. This paper discusses the various types of research needed and focuses attention on the issues dealing with technical and practical problems.

41205 **The compatibility of energy efficiency and indoor air quality in residences.** Grimsrud, D.T.; Sextro, R.G.; Turk, B.H. (Lawrence Berkeley Lab.). pp 7.90 of Proceedings from the ACEEE 1986 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1986). (CONF-860818—).

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

This presentation examines the existing field data from projects and programs in which the ventilation rates were changed. In most cases these occur in weatherization programs in which thermal losses are reduced by adding insulation and reducing air leakage. In some situations we examine projects in which ventilation rates were deliberately increased, e.g., through the addition of an air-to-air heat exchanger to examine its effect on indoor pollutant concentrations. The changes that have been observed in indoor air quality due to weatherization have been modest. Nonetheless they have been observed in some situations and should occur if sources remain constant. Weatherization can result in an aggregate gain in indoor air quality if simple pollutant measurements occur in the buildings to identify problem structures. If mitigation occurs to correct the problems (a task that does not require herioc efforts), then there is a net benefit to public health.

41206 **Retrofit wall insulation study.** Flores, J.A. (Bonneville Power Administration). pp 2.122-2.124 of Proceedings from the ACEEE 1986 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1986). (CONF-860818—).

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

Retrofit wall insulation is primarily intended to reduce the thermal conductivity of walls so that less energy will be transmitted through them. It can also reduce energy losses due to infiltration and can reduce the discomfort of interior draftiness. However, the value of retrofit wall insulation as a conservation measure is dependent upon the quality of its installation. Settling, incomplete filling of cavities, empty cavities, etc., can greatly reduce the effectiveness of the insulation. The Bonneville Power Administration (BPA) conducted a series of retrofit wall insulation tests to determine how various obstructions and discontinuities within a wall cavity might affect the complete filling of that cavity. All tests were conducted by local weatherizaton contractors, except for one cellulose test that was conducted by a manufacturer of cellulose insulation. All filling processes and techniques were left to the discretion of the contractor, except for the use of the one or two-hole filling method which was specified by BPA. The preliminary results are presented. The data is currently being organized and has not yet been analyzed. The most obvious observation was that the quality of the installation job was very dependent upon the contractors experience.

41207 **State of Minnesota high level weatherization project.** Shen, L.; Meixel, G. Jr.; Fagerson, M.; Nelson, G.; Wilson, T.; Belshe, R. (Univ. of Minnesota). pp 2.273-2.275 of Proceedings from the ACEEE 1986 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1986). (CONF-860818—).

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

In 1984 the Minnesota Department of Energy and Economic Development contracted with the University of Minnesota, Underground Space Center to carry out research on weatherization of low income houses. One of the components of this research was the high level weatherization study. The high level weatherization study was designed in order to assist the Community Action Programs (CAP's) in determining the most cost-effective method of weatherizing low-income housing. The intent of the project was to study the auditing diagnostic procedures, the process for selecting the weatherization interventions given the available resources, and the quality of the resulting weatherization work. The focus of this approach was to evaluate the auditing methodology and to identify

diagnostic procedures which would facilitate the auditor and work crews in their selection of weatherization interventions for each individual house. The preliminary findings of available data show that the high level houses have obtained an average total NAC savings of 25% and a heating only NAC savings of 35%. Figure 1 shows the pre- and post-NAC for the high level houses. This compares to 8% savings in total NAC for a group of standard houses from a statewide data base and a 10% savings in heating only NAC. Basement temperatures in the high level houses increased between 5 to 8°F and first floor temperatures decreased by 1.5°F.

41208 **Energy savings in 12 multifamily buildings retrofitted under a shared savings program.** Nevitt, R.M.; Stefanson, V.W. (St. Paul Energy Resource Center). pp 2.217-2.219 of Proceedings from the ACEEE 1986 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1986). (CONF-860818—).

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

Since 1983, the Energy Resource Center has invested over $450,000 in multifamily energy conservation retrofits through its Shared Savings Financing Program. The performance of 12 buildings (each having 5 to 33 units) retrofitted under this program was monitored over the 1985-86 heating season to determine the accuracy of audit predictions and to analyze the cost-effectiveness of energy efficiency retrofits in apartment buildings. Predicted energy savings were calculated using a computerized audit (CIRA 1.0) developed by LBL, along with estimates for heating system improvements provided by a local consulting engineer. Data collected at the buildings included total building natural gas consumption on a bi-weekly basis, as well as submetered domestic hot water and space heat gas consumption at seven buildings. At three of the sites, individual heating system components were turned on and off every two weeks to provide data on the effectiveness of the individual components. Normalized annual energy consumption for each building was estimated using the Princeton Scorekeeping Model.

41209 **Recent results: SERI's development of advanced glazings.** Potter, T.F.; Benson, D.K. (Solar Energy Research Institute). pp 2.244-2.256 of Proceedings from the ACEEE 1986 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1986). (CONF-860818—).

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

Progress since these new window designs were presented at the 1984 ACEEE Summer Study is described. Laboratory tests of stress failure and thermal conductance of the R-10 vacuum window are continuing. Current results are presented that confirm previous conclusions, based on simulations, that such a glazing configuration is 1) possible and 2) a significant improvement over current low-emittance (low-e) window designs. Improved economic analyses are also presented. Further progress in developing solid-state electrochromic window coatings is described as well. Such coatings can provide automatic, electronic control over the admittance of daylight and solar heat gains through windows. In particular, the recent achievement in obtaining a neutral gray electrochromic coating, significant in the optimization of daylighting benefits, is discussed.

41210 **Keeping warm: Findings from the Kansas City warm room retrofit project.** Wagner, B.S.; Diamond, R.C. (Lawrence Berkeley Lab.). pp 2.276-2.288 of Proceedings from the ACEEE 1986 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1986). (CONF-860818—). Contract AC03-76SF00098.

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

The warm room retrofit is a response to a common problem: how to stay warm in a large, poorly insulated house during the coldest parts of winter. The problem is especially acute for low-income and elderly homeowners. The retrofit is a combination of zoning, heating systems modification and insulation which allows the occupant to heat selected areas of her home while maintaining the unused areas at a cooler temperature. This study presents the results from a retrofit project in Kansas City, sponsored by the Urban Consortium in 1985-86. Nine houses were selected for the study, four controls and five houses that received the warm room retrofit. The costs of the retrofit averaged $1425 per house. Our analysis included regressions of total gas use versus outdoor temperatures to measure savings, which averaged 26 percent. Because of potential health and safety problems, the authors also measured indoor air quality before and after the retrofit, sampling levels of indoor radon, nitrogen dioxide, and formaldehyde. An important part of the study was to determine occupant response and the acceptability of the retrofit. The residents participated in the design of the retrofits, and were interviewed after the retrofits were installed to determine improvements in comfort and their satisfaction with the results.

41211 **Fuel savings analysis: "House doctoring" and storm windows.** Nadel, S.M.; Heineman, M.C. (Environmental Science Dept., Massachusetts Audubon Society). pp 2.191-2.203 of Proceedings from the ACEEE 1986 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1986). (CONF-860818—).

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

For the past three years the Massachusetts Audubon Society (MAS) and the Massachusetts Executive Office of Communities and Development (MEOCD) have conducted fuel savings evaluations on the low-income weatherization programs operated by MEOCD with funding from the U.S. Department of Energy and other sources. This year's study, which took place during the 1985-86 heating season, evaluated the fuel savings attributable to exterior storm windows and "house doctoring". Comparison with the results of last year's MAS/MEOCD study show that house doctoring is less cost-effective than the full Weatherization Assistance Program (WAP) operated by MEOCD and approximately the same cost-effectiveness as standard caulking and weatherstripping work. Storm windows are effective at saving energy, but given their fairly high cost, the fact they are not always used properly, and the fact they are exposed to the elements and deteriorate over time; they are probably not as cost-effective as the full WAP program. Based on these findings, we recommend that storm windows remain, and house doctoring become, low-priority weatherization measures for MEOCD energy conservation programs.

41212 **Analyzing energy conservation retrofits in public housing: Savings, cost-effectiveness, and policy implications.** Greely, K.M.; Goldman, C.A.; Ritschard, R.L. (Lawrence Berkeley Lab.). pp 2.125-2.137 of Proceedings from the ACEEE 1986 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1986). (CONF-860818—).

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

In this paper, the authors calculate energy savings and economic indicators for 43 retrofits, using consumption and cost data collected from case studies, housing authorities, and utilities. These results are compared with savings from conservation measures in privately owned, multi-family housing. Heating system controls and window measures were the two most frequent retrofit strategies in the housing projects they examined. Median energy savings are 14% of pre-retrofit consumption, or 11.2 MBtu/unit-year; savings ranged from -7% to 62%. A median payback time of 12 years showed the retrofits, as a group, to be less cost-effective than a comparable sample of retrofit efforts in privately owned, multi-family buildings. The authors also examine the persistence of energy savings for a small sample of buildings for which they have several years of post-retrofit utility billing data; preliminary results suggest that proper maintenance is a critical factor in sustaining energy savings after temperature control retrofits in steam-heated buildings. Finally, they discuss qualitative factors that influence the

acceptability of retrofits, including effects on comfort, building appearance, and security.

41213 **Daylighting in the Mt. Airy Public Library.** Adegran, M.; Andersson, B.; Place, W. (Building Systems Analysis Group, Lawrence Berkeley Lab., Berkeley, CA 94720). *Passive Solar Journal;* 3: No. 4, 349-386(1986). Contract AC03-76SF00098.

Results are presented from a detailed case study that evaluates the visual environment of a daylit building, the Mt. Airy Public Library, in Mt. Airy, North Carolina. This passive solar building is designed to save energy through the use of daylighting from south-facing clerestories, in combination with more traditional energy-conserving techniques. It is part of the U.S. Department of Energy's Non-Residential Experimental Passive Buildings Program and has been evaluated during the design and construction phases as well as monitored during more than a year of occupancy. This case study focuses on the quality of the daylight and compares it to recommended practice and alternative lighting environments. The authors carefully measured and observed light distribution throughout the entire building, including luminance distribution, task luminance, contrast rendering, and veiling reflections. They also observed and interviewed occupants concerning their responses to daylighting, electric lighting, and lighting control opportunities.

41214 **The attractive economics of thermal storage in new buildings.** De la Moriniere, O. (Lawrence Berkeley Lab., Berkeley, CA). pp 189-200 of Proceedings of the second great PG&E energy expo, 1985. Smith, C.B.; Davis, T.; Turnbull, P.W. Elmsford, NY; Pergamon Books Inc. (1985). (CONF-850583—). Contract AC03-76SF00098.

From Great PG and E energy expo '85 - meeting energy challenges; Oakland, CA, USA (21 May 1985).

The author studies the economics of cool storage in buildings for load management to avoid electric demand charges, and show that it is a very attractive investment. Two strategies are presented in this paper. Partial storage uses a chiller, sized to run continuously. On a summer night, the excess chiller capacity goes to storing coolth, then the next afternoon this coolth is used to supplement the chiller. Demand-optimized storage minimizes cost of operation by installing a somewhat larger chiller, sized to be able to turn off when power is most expensive. Both chiller and storage must be about 40% larger than what is required for partial storage. So one is faced with an interesting social problem: market forces are likely to induce mostly partial storage among customers while the interest of society is to see them climb the step up to demand-limited storage, because it is still far less expensive to save a peak kW than to produce it. The author recommends that utilities and policy makers should define inducements programs.

3202 Transportation

41215 **(PB—87-183273/XAB) Private-sector involvement in urban transportation. Final report, 1985-1986.** (Rice Center, Houston, TX (USA)). Dec 1986. 40p. NTIS, PC A03/MF A01.

See also PB—87-170015.

The report documents ways to involve the private sector in the planning and implementation of highway and transit systems, and recommends procedures for improving public/private partnerships in urban transportation at the State, regional, and local levels. The report provides a broad overview of the opportunities available and briefly reviews a wide variety of techniques followed by successful applications in 20 cities across the Nation. These case studies cover the highway and transit modes and represent all major groups of private-sector participants, including local businesses and community groups, major developers and transit service providers. Six of those cases were studied in greater detail.

41216 **(PB—87-187597/XAB) Preliminary assessment of the feasibility of an exclusive truck facility for Beaumont-Houston corridor. Interim research report, September 1984-September 1986.** Stokes, R.W.; Albert, S. (Texas A and M Univ., College Station (USA). Texas Transportation Inst.). Sep 1986. 38p. (TTI—2-10-85-393-2). NTIS, PC A03/MF A01.

The report examines, in general terms, the feasibility of several truck-facility options in the Beaumont-Houston corridor. Specific attention is given to the feasibility of exclusive truck facilities on or adjacent to I-10E and US 90.

41217 **(PB—87-187605/XAB) North Freeway Transitway: evaluation of the first year of barrier-separated operation. Research report (Interim), September 1983-February 1987.** Kuo, N.M. (Texas A and M Univ., College Station (USA). Texas Transportation Inst.). Feb 1987. 108p. (TTI—2-10-84-339-9). NTIS, PC A06/MF A01.

The report documents the development, construction, and subsequent first year's operation of the North Freeway (I-45N) Transitway in Houston, Texas. The facility and its immediate predecessor, the North Freeway Contraflow Project, are described. A detailed discussion of the problems and unique solutions encountered during the construction and contraflow-to-transitway transition process are also described. Impacts to mainlane traffic, both in the peak and in the off-peak direction, are assessed through an analysis of travel times and speeds, vehicle and passenger flow rates, and freeway accident rates. Transitway operation is assessed through an analysis of HOV demand volumes and peaking characteristics, park-and-ride volumes, travel time savings, occupancy rates, violation rates, disabled vehicle incident rates, and a variety of other performance measures. Comparisons of corridor operations during the contraflow operating period, during the construction period, and during the transitway operating period are discussed and evaluated.

41218 **(PB—87-187688/XAB) Economic assessment of potential solutions for improving motorist route following. Volume 2. Final report.** King, G.E. (KLD Associates, Inc., Huntington, NY (USA)). Apr 1986. 127p. (KLD-TR—172B). NTIS, PC A07/MF A01.

See also Volume 1, PB—87-152195, and Volume 3, PB—87-187704.

The study quantified the extent of excess travel due to inefficient highway navigation for non-commercial vehicles in the United States in terms of both distance and time. Estimates of the consequences of the excess travel in terms of vehicle operating costs, accident potential and lost time are presented. Potential remedial measures are described and evaluated. It was found that recoverable navigational waste amount to 6.4% of all distance traveled by non-commercial vehicles and 12.0% of all time spent in such travel. The estimated costs to individuals and to society of the excess travel is estimated at $45.7 billion considering only vehicle operating and accident costs and the value of time.

41219 **(PB—87-187704/XAB) Economic assessment of potential solutions for improving motorist route following. Volume 3. Final report: appendices.** King, G.F. (KLD Associates, Inc., Huntington, NY (USA)). Apr 1986. 134p. (KLD-TR—172C). NTIS, PC A07/MF A01.

See also Volume 2, PB—87-187688 and Volume 4, PB—87-187712.

The study quantified the extent of excess travel due to inefficient highway navigation for non-commercial vehicles in the United States in terms of both distance and time. Estimates of the consequences of the excess travel in terms of vehicle operating costs, accident potential and lost time are presented. Potential remedial measures are described and evaluated.

41220 **(PB—87-187712/XAB) Economic assessment of potential solutions for improving motorist route following. Volume 4. Interim report - Task A - literature synthesis. Final report, September 1983-September 1985.** King, G.E. (KLD Associates, Inc., Huntington, NY (USA)). Apr 1986. 209p. (KLD-TR—146). NTIS, PC A10/MF A01.

See also Volume 3, PB—87-187704.

The study quantified the extent of excess travel due to inefficient highway navigation for non-commercial vehicles in the United States in terms of both distance and time. Estimates of the consequences of the excess travel in terms of vehicle operating costs are described and evaluated.

41221 **(PB—87-187852/XAB) Impacts of carpool utilization on the Katy Freeway authorized vehicle lane 12-month after evaluation. Interim report, September 1984-August 1986.** Christiansen, D.L.; McCasland, W.R. (Texas A and M Univ., College Station (USA). Texas Transportation Inst.). Aug 1986. 58p. (TTI—2-10-85-484-3). NTIS, PC A04/MF A01.

See also PB—87-121919.

The report documents the data collected in April through June 1986, one year after carpool utilization of the authorized vehicle lane (AVL) was permitted. Comprehensive traffic data, both on the AVL and the freeway, were collected. In addition, surveys of transit users on the AVL, vanpool drivers on the AVL, vanpool passengers on the AVL, carpool drivers on the AVL, carpool passengers on the AVL, and motorists not using the AVL were undertaken. In the report, these data are compared to similar data collected before carpool utilization was permitted to identify the impacts of permitting carpools to use the AVL.

41222 **(PB—87-188165/XAB) Procedures for estimating park-and-ride demand in large Texas cities. Interim report, September 1983-February 1987.** Nungesser, L.G.; Ledbetter, N.P. (Texas A and M Univ., College Station (USA). Texas Transportation Inst.). Feb 1987. 95p. (TTI—2-10-84-339-7). NTIS, PC A05/MF A01.

Numerous park-and-ride lots are being developed in Texas. The report develops techniques to estimate the ranges in ridership that will likely occur at park-and-ride lots in large urban areas. The data base employed to develop these techniques uses the experiences of 16 park-and-ride lots in Houston, Texas. Several of these models are then applied to Dallas park-and-ride lots. The demand-estimation techniques presented are intended to be relatively easy and inexpensive to apply and use only data that are readily available for Texas urban areas. These techniques are also developed to estimate the impact of high-occupancy vehicle lanes, also called authorized vehicle lanes, on park-and-ride lot utilization.

41223 **(PB—87-188173/XAB) Safety and operational evaluation of shoulders on urban freeways. Research report (Interim), September 1983-February 1987.** Urbanik, T.; Bonilla, C.R. (Texas A and M Univ., College Station (USA). Texas Transportation Inst.). Feb 1987. 186p. (TTI—2-18-84-395-1). NTIS, PC A09/MF A01.

The study addresses two issues concerning shoulder removals: safety and traffic operations. Improvement of traffic flow is the primary reason for considering shoulder removals. However, extensive removal of both shoulders appears to be counter productive. Overall safety is improved on study sections where inside shoulders are removed to add capacity on very congested roadways (ADT greater than 20,000 vehicles per lane per day) and the congestion is reduced (ADT per lane less than 18,000 vehicles per lane per day). The improved safety appears to be the result of improved traffic operation. If congestion is less severe, then safety appears to be unchanged where inside shoulders are removed. Inside shoulder removals appear to be preferable to outside shoulder removals.

41224 **(PB—87-188181/XAB) Preliminary assessment of the feasibility of converting the I-10 frontage roads to an exclusive truck facility. Interim research report, September 1984-September 1986.** Albert, S. (Texas A and M Univ., College Station (USA). Texas Transportation Inst.). Sep 1986. 54p. (TTI—2-10-85-393-1). NTIS, PC A04/MF A01.

The report examines the physical and economical feasibility of converting rural frontage roads to an exclusive truck facility. The I-10 freeway corridor from Houston to Beaumont is selected for the evaluation. Three basic options are incorporated in the analysis. These are: (1) assign truck traffic to existing frontage roads; (2) construct exclusive facility on one side of freeway, and; (3) construct exclusive facility on both sides of freeway.

41225 **(PB—87-190351/XAB) Rail-modernization study. Final report.** (Gannett Fleming Transportation Engineers, Inc., Camp Hill, PA (USA)). Apr 1987. 340p. NTIS, PC A15/MF A01.

See also PB—87-190369.

The purposes of the study were to: (1) assess the costs for a ten-year period of aesthetics for new rail systems and for rehabilitating and modernizing existing rail systems to levels consistent with current standards of safety and reliability, and (2) provide an initial cost/ benefit assessment of the proposed improvements and associated costs. The study deals with 34 rapid, light and commuter rail systems and was based on an earlier study design effort.

41226 **(PB—87-190369/XAB) Rail-modernization study. Final report. Appendix: development of the cost-effectiveness methodology.** (Gannett Fleming Transportation Engineers, Inc., Camp Hill, PA (USA)). Apr 1987. 146p. NTIS, PC A07/MF A01.

See also PB—87-190351.

The cost-effectiveness methodology focuses on the economic rationale for the weights or modifiers used to calculate benefits. The modifiers allowed the direct estimation of benefits achieved from the specific levels of improvement to different system elements in the study. The modifiers were developed by quantifying the benefits of improvements for individual elements of work under two headings: (1) cost savings, which are dependent on the type of rail system, change in condition, and the scale of the work, and (2) passenger-related benefits, which are determined by the change in condition, the scale of the work, and the number of passenger miles affected.

41227 **(PB—87-190575/XAB) Analysis of survey data from the Katy and North transitways. Interim report, September 1984-March 1987.** Bullard, D.L. (Texas A and M Univ., College Station (USA). Texas Transportation Inst.). Mar 1987. 126p. (TTI—2-10-85-484-4). NTIS, PC A07/MF A01.

A major commitment was made in the Houston metropolitan area to develop physically separated authorized vehicles lanes (AVLs) or transitways in the medians of the existing freeway system. These lanes are reserved for high-occupancy vehicles. To date, portions of two transitways are operational -- one on the Katy Freeway in West Houston and one on the North Freeway serving North Houston. The report presents the results of transitway user and nonuser surveys performed in the Katy and North Freeway corridors. In addition to obtaining socioeconomic, demographic, and travel information, the surveys were designed to: (1) determine perceptions of the level of utilization of the transitways; (2) identify why individuals have chosen their present travel mode; and (3) assess attitudes and impacts pertaining to the transitways.

3203 Industry And Agriculture

REFER ALSO TO CITATION(S) 41092, 41110, 41254, 41448, 41678, 42033

41228 **(BMFT-FB-T—86-161) Adsorptive solvent recovery with energy saving regeneration. Final report.** Mellech, L.; Pilarczyk, E. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Bergbau-Forschung G.m.b.H. Forschungsinstitut des Steinkohlenbergbauvereins, Essen (Germany, F.R.). Abt. Kohlechemie). Dec 1986. 41p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE87770218.

Experiments in a lab and pilot plant with different solvents have shown that activated carbons used in solvent recovery can be regenerated by purging with carbon dioxide at 50-300 mbar and 40-50/sup 0/C. A dry diaphragm pump can be used for evacuation. The solvents desorbed during purging at low pressure can be condensed and recovered directly as pure liquids in a water-cooled condensate separator. Lower operating cost have been calculated for regeneration by purging with carbon dioxide at low pressure than for conventional steaming if water-soluble solvents have to be recovered. The operating cost are comparable if the solvents are insoluble in water. With 5 refs., 1 tab., 23 figs.

41229 **(BMFT-FB-T—86-167) Development and testing of burners for utilizing low-calory blast furnace gas together with pure oxygen in high-temperature furnaces. Final report.** Bastisch, G. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Kloeckner Stahl G.m.b.H., Bremen (Germany, F.R.)). Dec 1986. 94p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE87770215.

The aim of the research project was to create a new application for the gas which occurs in the dome of blast furnaces. A method was sought for using this gas in high-temperature furnaces (rolling mill furnaces) as a valuable substitute for fossil primary energy sources and other strong gases. This involved designing furnaces which fulfil both the safety requirements and technical requirements for the burning of pure oxygen in furnaces. Over a period of 2 1/2 years two different types of burner were developed together with the associated testing plant and tests were conducted. In the opinion of Kloeckner Stahl GmbH the system developed for running burners on blast furnace gas and pure oxygen were convincingly demonstrated as being technically feasible. With 15 refs., 4 tabs., 17 figs.

41230 **(BMFT-FB-T—86-177) Preheating and cleaning of scrap for oxygen steel production with synchronized use of converter offgas. 1. Test plant. Final report.** Geck, H.G.; Selenz, H.J. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Kloeckner-Werke A.G., Osnabrueck (Germany, F.R.). Werk Georgsmarienhuette). Dec 1986. 42p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE87770219.

Preheating of scrap for use in the allothermic KS process using excess converter offgas was the aim of the project. On the basis of the heating process that occurs directly in the scrap bucket, operating equipment and process posibilities for non-metallic contaminant removal exist from the preliminary heating with the resultant offgas. For the new process the scrap is loaded into a modified scrap bucket which is provided with a perforated floor. Special heating stand is used so that with the help of a fan generating low pressure in the scrap bucket the hot gas which is generated in a burner from converter gas can be delivered through a distributor covering the bucket and flow through the scrap contents. Within the test program more than 500 scrap buckets of preheated material were used in the steelworks. From a hot gas temperature of 960/ sup 0/C the scrap attained a preheated temperature of from 450 to 550/sup 0/C. The thermal efficiency of the preheating plant was 60 to 70%. Reduction of primary energy within the steel production process amounted to 15 to 20% with the exclusive use of solid feed materials. Transferring the results to an autothermic process such as an LD process would mean an increase in the scrap of 3 to 5% with the possibility of minimizing the cost of steel production through optimizing the various iron unit raw material costs. With 15 refs., 3 tabs., 15 figs.

41231 (CONF-8610169—, pp vp) **Industrial heat pump role definitions: technologies, economics and applications.** Chappell, R.N. 1986. NTIS, PC A 01. File Number DE87007089.

From Department of Energy industrial heat pump workshop; Atlanta, GA, USA (14 Oct 1986).

There is presently considerable controversy over the role of heat pumps in industrial processes. The US Department of Energy (DOE) and the Electric Power Research Institute have recently embarked on separate but coordinated studies to investigate the potential for heat pumps from the process synthesis point of view. Some processes proved to be not amendable to heat pump integration while others showed potential energy reductions in excess of 50%. Profiles were produced of those process characteristics which lend themselves most readily to reduction in energy consumption through heat pumping. The same studies have also revealed characteristics which heat pumps must have to be beneficial to industrial processes. DOE has also recently completed a detailed economic analysis of state-of-the-art heat pumps. While the DOE objective of both the economic analysis and the process studies is to guide the DOE heat pump program, a great deal of information resulted which can increase profitability of industrial processing firms and provide valuable insight to those companies serving them.

41232 (CONF-8610169—, pp vp) **DOE's industrial heat pump program - an invitation to industrial participation.** Richlen, S. (Dept. of Energy, Washington, DC). 1986. NTIS, PC A 01. File Number DE87007089.

From Department of Energy industrial heat pump workshop; Atlanta, GA, USA (14 Oct 1986).

The Department of Energy's (DOE) Industrial Heat Pump Program is discussed. The goal of this program is to advance the technology available for designing fabricating, and using heat pumps to increase the energy use efficiency in American industry. It involves using heat pumps in a role of both increasing the process efficiency and recovering and reusing waste energy emitted by the process. An invitation is extended to industry to participate in the DOE Industrial Heat Pump Program.

41233 (CONF-8610169—, pp vp) **Introduction to pinch technology.** Spriggs, H.D.; Shah, J.V. (Linnhoff March Ltd., Leesburg, VA). 1986. NTIS, PC A 01. File Number DE87007089.

From Department of Energy industrial heat pump workshop; Atlanta, GA, USA (14 Oct 1986).

Process integration based on pinch technology constitutes a new and powerful approach to process design which yields significantly improved and lower cost processes. These techniques are applicable to essentially all of the process industries including food and drink, pump and paper, chemical, and petrochemical. The techniques are based on the fundamentals of thermodynamics, mathematics, and engineering science and they incorporate the real economics of the particular company and plant location. The techniques apply equally well to new designs and to the retrofit of existing plants. Pinch technology begins with the energy picture of the plant, showing interactions among all unit operations using composite heating and cooling curves. These composite curves identify the most constrained part of the process, the process pinch. The curves allow calculation of energy and capital targets before the design of the energy recovery network. The optimum balance between energy and capital is established at this point. The composite curves also provide information which guides modification of the reaction and separation systems in the plant to reduce energy and capital targets. This approach to process design using pinch technology is illustrated using an actual study performed in 1986. Typical results show that up to 20-50% of the energy to operate such plants can be saved with a simple payback on capital of two years or less.

41234 (CONF-8610169—, pp vp) **Industrial heat pumps: new insights on their integration in total sites.** Ranade, S.M. (TENSA Services, Houston, TX). 1986. NTIS, PC A 01. File Number DE87007089.

From Department of Energy industrial heat pump workshop; Atlanta, GA, USA (14 Oct 1986).

Most modern day industrial complexes are total sites consisting of processes and the facilities that supply the process heat and power. Any meaningful heat pump integration procedure should, therefore, be based on a clear understanding of the site thermodynamics and economics, especially the utility system-process interactions. Pinch technology provides an excellent framework for systematic analysis of such interactions. Options for appropriate placement of heat pumps in total sites are discussed. A general equation for maximum economic lift is presented. Application of this equation to different heat pump types provide some novel insights on role and characteristics of heat pumps. An expression for maximum theoretical economic lift is also derived. This expression can be used to define, apriori, the region in temperature space for optimal integration of heat pumps.

41235 (CONF-8610169—, pp vp) **Heat pumps in evaporation.** Witherell, W.D.; Conneway, F.A. (Union Carbide Corp., South Charleston, WV). 1986. NTIS, PC A 01. File Number DE87007089.

From Department of Energy industrial heat pump workshop; Atlanta, GA, USA (14 Oct 1986).

Many unit operations in the process industries are designed in isolation without adequately considering the potential for energy integration with the surrounding process. This practice is evident in the design of evaporators for the process industries. Evaporation

system design is often completed and only partially optimized within the constraints of the evaporation requirement itself. However, the real question remains unanswered: has the corrent evaporation system been specified, especially when considering integration potential with the surrounding process? The results of a Process Synthesis Study for the Electric Power Research Institute (EPRI) of Palo Alto, California are presented. The study objective was to evaluate the potential for utilizing electric heat pumps in evaporation processes within the process industries. Using process synthesis techniques, a study was completed on ten evaporation intensive processes from within five process industries. The results for each process are summarized, especially the feasibility of utilizing electric heat pumps in the evaporation system. The effect of considering the surrounding process in the design of the correct evaporation system is also discussed for both retrofits and new designs. Conclusions are presented to facilitate generalized guidelines for proper evaporation system design. Process Synthesis techniques that are relevant for proper data extraction and evaporation system design are discussed to appropriately demonstrate correct application of the technology. Identification of various types of background processes and how they interact with the evaporation system are also discussed.

41236 (CONF-8610169—, pp vp) **Identifying heat pump opportunities in process industries.** Hindmarsh, E. (TENSA Services, Houston, TX). 1986. NTIS, PC A 01. File Number DE87007089.

From Department of Energy industrial heat pump workshop; Atlanta, GA, USA (14 Oct 1986).

For the past year, TENSA Services has been conducting research on the optimum placement of heat pumps in industrial processes with funding from the US Department of Energy. As the study draws to a conclusion, the research has yielded several important trends as well as the discovery of potential heat pump applications over a range of industries. The theory of heat pump placement in industrial processes is discussed and results of the DOE sponsored work are reported.

41237 (CONF-8610169—, pp vp) **Heat pump strategies and payoffs.** Gilbert, J.S. (Dames & Moore, Washington, DC). 1986. NTIS, PC A 01. File Number DE87007089.

From Department of Energy industrial heat pump workshop; Atlanta, GA, USA (14 Oct 1986).

After evaluating numerous waste heat sources and heat pump designs for energy recovery, it was evident that a great deal of confusion exists about the economics of heat pumps. The purpose of this article is to present some simple formulas that will indicate the economics of heat pump systems so that the reader may easily determine which heat pump applications are most cost effective. Commercially available equipment is considered to determine the near-term and future economic viability of each approach as a function of the source and user temperatures, and magnitude of heat flow. Generic heat pumps, including vapor recompression designs are explained, costed, estimated in performance, and evaluated as a function of basic economic parameters such as local utility and fuel rates. Steam recompression and generation of steam from moist, hot air are also investigated specifically.

41238 (CONF-8610169—, pp vp) **Utility's role in the industrial application of applied heat pumps.** Pucciano, F.J. (Georgia Power & Light Co., Atlanta). 1986. NTIS, PC A 01. File Number DE87007089.

From Department of Energy industrial heat pump workshop; Atlanta, GA, USA (14 Oct 1986).

The role of the utility in promoting mechanical heat recovery systems and their effect on industry/utility load profiles, thermal economics and alternative fuel selection are discussed. These systems include applied heat pumps, thermal storage and load control. The discussion compares these systems to boiler operations and cogeneration. How mechanical heat recovery systems can be integrated into the overall thermal plant of an industry to obtain maximum thermal efficiency, low cost energy and production improvements and/or redundancy is explained. How existing boiler plants are improved and cogeneration potential is reduced is explained. How existing boiler plants are improved and cogeneration potential is reduced is also explained. The steps a utility should take to influence acceptance and installation of these systems is developed.

41239 (CONF-8610169—, pp vp) **Air or Brayton cycle solvent recovery system.** Fox, B.J. (3M Co., St. Paul, MN). 1986. NTIS, PC A 01. File Number DE87007089.

From Department of Energy industrial heat pump workshop; Atlanta, GA, USA (14 Oct 1986).

The required temperature and technique for condensing common industrial solvents from the exhaust air of drying ovens is explained. The benefits of the Air Cycle for this application are discussed. The operation of the 8000 CFM Air Cycle Solvent Recovery System developed by the AiResearch Manufacturing Company of California under contract to the Department of Energy is discussed. Performance data for the recovery of solvents from an industrial drying oven is presented. The advantages of the free spindle arrangement as an alternate to the present gear drive are explained. The simple method for adjusting and controlling the turbine exhaust temperature for the free spindle arrangement is explained. The application of the Air Cycle for condensing solvent vapors from inert atmosphere ovens and from activated carbon desorbed with nitrogen is also described. Relative merits of the Air Cycle System compared with other available methods of solvent recovery are discussed.

41240 (CONF-8610169—, pp vp) **Industrial heat pump systems: a European perspective.** Berghmans, J. (Catholic Univ. Leuven, Heverlee, Belgium). 1986. NTIS, PC A 01. File Number DE87007089.

From Department of Energy industrial heat pump workshop; Atlanta, GA, USA (14 Oct 1986).

The activities regarding the use of industrial heat pumps in Europe are discussed. Also, IEA activities are included as they are organized through the IEA Secretariat in Paris, France. It is hoped that this discussion will incite parties interested in industrial heat pumps in the US to obtain more detailed information regarding the heat pump experience in Europe.

41241 (CONF-8610169—, pp vp) **Process integration of industrial heat pumps.** Priebe, S.J.; Chappell, R.N. (EG & G Idaho, Inc., Idaho Falls). 1986. NTIS, PC A 01. File Number DE87007089.

From Department of Energy industrial heat pump workshop; Atlanta, GA, USA (14 Oct 1986).

The integration of heat pumps into industrial processes shows potential for energy savings. Heat pumps must, however, be integrated properly relative to the process pinch and the unit operations in the process. The shape of the grand composite curve, the type of heat pump drive, and the kind of heat pump cycle were examined to determine their effects on the placement of industrial heat pumps. Finally, three sample industrial processes were studied to determine potential energy savings from the addition of heat pumps. Results ranged from 9% to 68% energy savings with paybacks ranging from 0.7 to 2.5 years.

41242 (CONF-8610169—, pp vp) **Heat-of-mixing chemical heat pump program.** Kaplan, S.I. (Oak Ridge National Lab., TN). 1986. NTIS, PC A 01. File Number DE87007089. Contract AC05-84OR21400.

From Department of Energy industrial heat pump workshop; Atlanta, GA, USA (14 Oct 1986).

Chemical Heat Pumps (CHPs) refers to heat pumps in which the temperature of the incoming heat is raised by energy released when two or more substances combine, rather than by mechanical vapor compression. Heat-of-Mixing CHPs, or HMCHPs, use the heat released when a vapor-phase refrigerant combines with a liquid or solid carrier or storage material. The types of mixing that are included in the category are: (a) absorption heat pumps, (b) adsorption heat pumps; and (c) by extension other solid/vapor reactions are included where loose, reversible chemical bonding occurs, such as H2/metal hydrides or NH3/metal salts, etc. The industrial HMCHP designs discussed are outgrowths of the steam-driven chillers and gas-fired refrigerators popular a few decades ago.

41243 (CONF-8610169—, pp vp) **Advanced industrial heat pump technologies.** Mills, J.I. (EG & G Idaho, Inc., Idaho Falls). 1986. NTIS, PC A 01. File Number DE87007089.

From Department of Energy industrial heat pump workshop; Atlanta, GA, USA (14 Oct 1986).

The Department of Energy (DOE) is attempting to advance the use of heat pumps to save energy in industrial processes. The approach has emphasized developing better heat pump technologies and transferring those technologies to the private sector. DOE requires that heat pump technologies selected for development be both applicable to industrial processes and economically advantageous. To be applicable to industrial processes, heat pumps must be capable of efficiently matching the lift and temperature requirements of the processes. To be economically feasible, new technologies for pumping heat must have the potential to provide process heat at lower cost than can be provided by alternative heat sources such as boilers or state-of-the-art heat pumps. The performance and economic goals that have been established for advanced industrial heat pump technologies are discussed. Alternative approaches for reaching these goals are also addressed. Finally, summaries of the magnetic and heat of reaction chemical heat pump programs, which are products of this advanced industrial heat pump development strategy, are presented.

41244 (CONF-8610169—, pp vp) **Need for cooperative R & D: case studies.** Felker, L.R.; Miller, S.L. (Dept. of Commerce, Washington, DC). 1986. NTIS, PC A 01. File Number DE87007089.

From Department of Energy industrial heat pump workshop; Atlanta, GA, USA (14 Oct 1986).

Cooperative research and development programs promote competition. They reduce duplication, make efficient use of scarce scientific and technical personnel, and help achieve desirable economies of scale. Small firms are able to collaborate on projects that, because of prohibitive costs, they could not perform on their own. Large firms are able to solve jointly today's large and complex technological problems, which often are beyond the technical or financial capability of individual companies. For these reasons, cooperative research efforts will play a key role in the ability of US industries to remain competitive in the international marketplace. The need for these cooperative research efforts is discussed.

41245 **(DOE/BP/20933—T1) Technical evaluation of Industrial Test Program: Wood products: Final report for Task Order No. 1.** (Mater Engineering Ltd., Corvallis, OR (USA)). Jan 1986. Contract AC79-85BP20933. 181p. NTIS, PC A09. File Number DE87011168.

The report presents the findings of our analysis of the 10 case studies on electrical energy conservation opportunities performed under the Bonneville Power Administration's (BPA) Industrial Test Program for Standard Industrial Classification (SIC) 2400 (Wood Products). Five studies were performed by Carroll, Hatch & Associates (CH & A) of Portland, Oregon, and five studies were performed by URS/ TransEnergy Systems of Seattle, Washington.

41246 **(DOE/CE—0184) Annual report to the Congress and the President on industrial energy efficiency improvement, 1985.** (USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC. Office of Industrial Programs). May 1987. 81p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87011085.

This report is divided into three sections: a presentation of data on energy consumption and efficiency across the entire industrial sector, a presentation of data and discussion on methods used to conserve energy for manufacturing industries grouped within each two-digit SIC category, and a brief discussion on industry progress in recovered materials utilization.

41247 **(DOE/CE/40606—T4) Ultrafiltration of Kraft Black Liquor: Phase II, Final report.** Hill, M.K. (Maine Univ., Orono (USA)). Sep 1987. Contract AC02-82CE40606. 186p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE87013555.

The major justification for examining ultrafiltration was to lower the viscosity of the Kraft Black Liquor by recovering it as an ultrafiltration permeate from which the highest MW lignin had been removed. The liquor could then be concentrated to a higher percentage solids before firing into the recovery boiler. Consequent energy savings for the 1000 ton/day pulp mill would be 2.05×10^{10} Btu/y for each percentage increase in TDS (total dissolved solids) to the recovery boiler. This Phase II report gives data on viscosity with percentage solids of KBL permeates. Another favorable effect of ultrafiltration on the permeate properties is disproportionate removal of multivalent ions including the major scaling ion Ca^{2+}. If this high-viscosity high-Ca retentate could be treated to lower its viscosity and to release the Ca in a non-scaling form, this would enhance the possibility that ultrafiltration might be useful in a mill situation. Included in this report are data on the results of treating the retentate fraction. Other justifications for this program included further information in KBL properties: lignin MW in the KBL at high pH; elemental and sugar analyses; and differential properties of lignins in the retentate and the permeate fractions. A preliminary economic analysis of ultrafiltration is contained in this report. These analyses indicate that with flux rates now attainable, ultrafiltration would not be economically justified at this time if the only justification is to lower KBL viscosity. For certain situations where high Ca liquors present a scaling problem, especially in an evaporator-limited mill, the economics are more favorable. There are also unsolved problems relating to the use of the high viscosity retentate.

41248 **(DOE/CE/40747—T1) Development plan for a coal/water slurry fired diesel engine for cogeneration applications: Final report.** Anson, D.; Barber, S.A.; Feldmann, H.F.; Gurney, M.D. (Battelle Columbus Labs., OH (USA)). Jul 1987. Contract AC02-86CE40747. 407p. NTIS, PC A18/ MF A01; 1; GPO Dep. File Number DE87012003.

This report describes a national program to develop large slow-speed diesel engines to operate on coal/water slurry (CWS) fuel in stationary applications. There should be no difficulty in operating engines with cylinder sizes larger than about 12-inch diameter and operating at speeds below 500 rpm. The development problems will be almost entirely related to wear of injection mechanisms, sliding members such as piston rings and cylinder liners, and possibly valves and turbocharger blades. Strategies discussed for the alleviation of these problems include changes in hardware configurations, materials, lubrication, and fuel formulations. These strategies form the basis of experimental approaches to engine development which include bench-scale, reduced-scale, and full-scale testing using both special test engines and multicylinder commercial prototypes. The report describes the facilities and staffing required for the development program and provides a planning-type cost estimate for building the facility and conducting a 5-year program which would carry development to the point where a conceptual commercial engine design could be produced. It also examines various options for facility ownership and organization.

41249 **(DOE/ER/10645—21) Process design and control strategies for enhanced energy efficiency and productivity in the process industries: Progress report for period May 1983-December 1985.** Ray, W.H.; Rudd, D.F. (Wisconsin Univ., Madison (USA). Dept. of Chemical Engineering). Aug 1986. Contract AC02-80ER10645. 31p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013395.

This report summarizes the results over the period May 1983 through December 1985. Significant progress has been made during this period and the research results are already being used by industry through the widespread acceptance of our Computer-aided control system design package, CONSYD. Areas of progress in improved process design include polymerization reactors and packed bed reactors, while research in process control system design has been progressing well for systems described by time delays, distributed parameter systems, nonlinear systems, and in adaptive control. In addition to the export of our results in CAD packages, the research results have also been disseminated through research papers, conference papers, short courses, and seminars.

41250 **Waste management trends: The interface of engineering with chemistry and toxicological monitoring.** Jolley, R.L. (Oak Ridge National Lab., Oak Ridge, TN). pp 50 of Proceedings of the symposia of the division of environmental chemistry of the American Chemical Society. Washington, DC; American Chemical Society (1987). (CONF-870410—). Contract AC05-84OR21400.

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

Successful waste management appears to be dependent on four major factors: good management practices and philosophy, dedicated, educated, experienced, and motivated personnel; appropriate and efficient waste treatment methods; and environmentally safe waste storage and disposal systems. Because of the complex nature of modern waste, the management of hazardous waste is a multidisciplinary effort requiring environmental and toxicological monitoring capabilities as well as chemical, geological, and engineering skills. This symposium was organized to inform the public and the scientific community about this developing trend. Symposium participants include waste managers from both the public and private sectors, nuclear and environmental engineers, chemists, toxicologists, physical scientists, and ecologists. These nationally known experts will explain how their many disciplines form the warp and woof of the nationally important waste management network protecting the health and future of the nation.

41251 **Analysis and planning of integrated waste management systems.** Rivera, A.L. (Oak Ridge National Lab., Oak Ridge, TN). pp 58-59 of Proceedings of the symposia of the division of environmental chemistry of the American Chemical Society. Washington, DC; American Chemical Society (1987). (CONF-870410—). Contract AC05-84OR21400.

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

Waste management decision/policy making seeks a balance between risk and economy. This balance is very difficult to achieve because of the interrelated regulatory, institutional, and technological uncertainties. These variables are affecting the rate of implementation of technical solutions to waste management problems, particularly in the areas of hazardous, radioactive, and mixed wastes. Waste management decision/policy makers are beginning to realize that a systems approach is needed in the implementation of cost-effective, regulator-approved, technical solutions to waste management problems. Waste systems generally involve a significant amount of resources or costs to the organization which is obtaining or maintaining them. Typical of such resource requirements are money, manpower, technology, material, energy information, or a combination of these. However, it is necessary to obtain management or corporate approval for the use of these resources. To obtain approval, it is essential that the value or benefit of the system relative to its cost be sufficient to warrant the expenditure. It is also necessary to establish the technical feasibility of the undertaking. Generally accepted criteria of overall system values are presented in this paper. Ratios or combinations of these criteria could also be employed as a criteria of values.

3206 Municipalities And Community Systems

REFER ALSO TO CITATION(S) 41155, 41161

41252 **(CONF-870621—1) Nonintrusive ultrasonic flow measurement techniques and their applications to Btu metering.** Sheen, S.H.; Karvelas, D.E.; Raptis, A.C. (Argonne National Lab., IL (USA)). Apr 1987. Contract W-31109-ENG-38. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011390.

From 78. International District Heating and Cooling Association conference; Baltimore, MD, USA (21 Jun 1987).

The paper reviews the state-of-the-art ultrasonic flow measurement techniques and assesses their potential application to BTU metering for District Heating and Cooling (DHC). The assessed techniques include Doppler, transit-time, and cross-correlation ultrasonic flowmeters which are currently available on the market. A novel modification of the flow instruments to include temperature measurement is also discussed. The modified flowmeter provides a direct measurement of heat content in hot water flow, thus, it allows one to meter the Btu consumption of a DHC system.

41253 **(ORNL/TM—10234) Characterization and potential of nonmetallic piping systems for district heating.** Barnes, M.H.; Karnitz, M.A.; Naus, D.J.; Bryson, J.W. Jr. (Oak Ridge National Lab., TN (USA)). Jul 1987. Contract AC05-84OR21400. 67p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87013372.

The objectives of this investigation were to characterize and evaluate the potential of nonmetallic piping systems for district heating applications. This investigation considered both currently available products and future products. Analyses of the cost components of district heating systems were performed for current steel heating piping technology. A comparison was then made with hypothetical nonmetallic piping technology, and opportunities where savings might occur were noted. As a result of these analyses, a conceptual design for a preinsulated, nonmetallic piping was developed to take advantage of likely areas of overall cost reduction. This design based on low-cost field fabrication and existing materials, used a postchlorinated polyvinylchloride carrier pipe supported structurally by high-density urethane foam and polyethylene jacketing. A structural analysis of this conceptual design was performed using two-dimensional, finite elements. The results are promising for practical operating temperatures.

41254 **(PB—87-191623/XAB) Waste incineration and emission-control technologies.** Brna, T.G.; Sedman, C.B. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). May 1987. 26p. (EPA—600/D-87/147). NTIS, PC A03/MF A01.

The paper gives results of a survey of available waste-incineration and emission-control technologies in the U.S., Japan, and Western Europe. Increasing concern over landfills as a waste-management option and the decreasing availability of sites have focused attention on incineration for destruction of hazardous wastes and volume reduction of other wastes in the U.S. Incineration requires the control of air-pollutant emissions, which can be minimized by combining in-furnace and post-combustion control technologies. Since future potential regulation of both hazardous air pollutants and acid-rain precursors may cause extensive retrofit or early termination of existing waste-incineration installations, planning for new or modified installations should recognize the various control technologies available in order to minimize future outlays if regulations are tightened.

41255 **(PB—87-194098/XAB) Energy in municipal-wastewater treatment: an energy-audit procedure and supporting data base. Final report.** (Carltech Associates, Columbia, MD (USA)). Jul 1986. 24p. NTIS, PC A02/MF A01.

See also Appendix A, PB—87-194106.

EPA regulations require a methodology for determining energy requirements of municipal wastewater treatment because treatment-plant construction and operation consume significant amounts of energy. Energy is a major driver of both operating and capital costs. In addition, most of the energy consumed is drawn from irreplaceable natural resources. In recognition of these factors, EPA requires analysis of the energy effectiveness of alternative types of wastewater treatment. The purpose of this project was to develop appropriate procedures to perform this analysis.

41256 **(PB—87-194106/XAB) Energy in municipal-wastewater treatment: an energy-audit procedure and supporting data base. Appendix A.** (Carltech Associates, Columbia, MD (USA)). Jul 1986. 121p. NTIS, PC A06/MF A01.

See also Final rept, PB—87-194098 and Appendix B, PB—87-194114.

These procedures can be used by planning and operating personnel to estimate the energy requirements of construction and operating Waste Water Treatment (WWT) unit processes. Acquisition energy includes both the embodied energies of the raw materials and the energy consumed in construction. Operating energy consists of energy consumed in plant operation but does not include the energies embodied in consumables such as chlorine, oxygen, and maintenance materials. The estimating procedures are based on typical plants but may be varied for significant differences in design parameters.

41257 **(PB—87-194114/XAB) Energy in municipal-wastewater treatment: an energy-audit procedure and supporting data base. Case examples. Appendix B.** (Carltech Associates, Columbia, MD (USA)). Jul 1986. 90p. NTIS, PC A05/MF A01.

See also Appendix A, PB—87-194106 and Appendix C, PB—87-194122.

This case example illustrates the application of the energy-estimation procedures to a 0.5 MGD wastewater treatment facility utilizing a trickling-filter system with anaerobic in the intermountain area of the United States.

41258 **(PB—87-194122/XAB) Energy in municipal-wastewater treatment: an energy-audit procedure and supporting data base. Alternative methodologies for estimations of embodied energies. Appendix C.** (Carltech Associates, Columbia, MD (USA)). Jul 1986. 23p. NTIS, PC A02/MF A01.

See also Appendix B, PB—87-194114.

A methodology for determining total energy requirements of municipal-wastewater treatment plants is needed to satisfy requirements of EPA's regulation pertaining to energy effectiveness of alternative technologies. Embodied energies of construction materials and consumable chemicals represents a significant energy demand. Both computer and manual literature searches were performed, and interviews were conducted with knowledgeable individuals to identify and evaluate promising new methods of estimating these embodied energies.

3209 Education And Public Relations

REFER ALSO TO CITATION(S) 41165, 41166, 41168, 41169, 41186, 41194

33 ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

3301 Internal Combustion Engines

REFER ALSO TO CITATION(S) 40457, 41124, 41264, 41265, 41266, 41267, 41268, 41269, 41270, 41272

41259 **(AD-A—180257/8/XAB) Evaluation of three military diesel-injection systems on alternative fuels. Interim report, November 1984-December 1986.** Callahan, T.J.; Bowden, J.N. (Southwest Research Inst., San Antonio, TX (USA). Belvoir Fuels and Lubricants Research Facility). Feb 1987. 40p. (BFLRF—214). NTIS, PC A03/MF A01.

Army diesel-powered vehicles are often required to operate in remote areas and in extreme ambient conditions, e.g., arctic or desert areas. Use of emergency fuels with less than optimum properties can result in unsatisfactory engine performance. This study examined the relationship between front-end volatility of the fuel and vapor lock at high fuel temperatures and the relationship between high-viscosity fuels and pump-filling problems at low fuel temperatures. Three Army diesel-injection systems representing the majority of Army equipment were selected for testing. Fuel flow-rate tests were conducted at both high and low fuel temperatures and at a variety of operating conditions. Test fuels were blended to provide fuels with a range of 10 percentage points for the high-temperature tests and fuels with a range of viscosities for the low-temperature tests. The front-end volatility of the fuel was not observed to present any problems at the high temperatures. However, fuel viscosity at both high and low temperatures was observed to affect the fuel flow rate for each injection system.

41260 **(AD-A—180313/9/XAB) Fuel-property effects on the cold startability of Navy high-speed diesel engines. Interim report, November 1983-December 1985.** Montemayor, A.F.; Owens, E.C.; Buckingham, J.P.; Jung, P.K.; Giannini, R.M. (Southwest Research Inst., San Antonio, TX (USA). Belvoir Fuels and Lubricants Research Facility). Dec 1985. 68p. (BFLRF—207). NTIS, PC A04/MF A01.

In this program, four Navy high-speed diesel engines were tested for startability at 5 C. The engines were Detroit Diesel Allison 4-53T, Detroit Diesel Allison 4-71TI, Cummins NH-220, and Westerbeke 4-108. Initially, starting time versus temperature curves were determined for each engine using a MIL-F-16884H base fuel. Next, starting timed at 5 C were determined for progressively lower-ignition-quality fuels. The test fuels were obtained by mixing progressively larger volumes of three-cetine fuels with the base fuel. Multiple linear regression analysis was performed using the cranking speed and fuel properties as the independent variables with starting time as the dependent variable. This yielded an equation for each engine that predicts starting time based on fuel properties and cranking speed.

41261 **(ANL/CNSV-TM—181) Test devices for investigation of piston-ring/cylinder-liner wear on coal-fueled diesel engines: Review and evaluation.** Stodolsky, F.; Sekar, R.; Aronov, V. (Argonne National Lab., IL (USA)). May 1987. Contract W-31109-ENG-38. 53p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87013195.

Literature on existing devices has been searched to determine their appropriateness for coal/water-slurry (CWS) diesel wear investigations. Parameters involved in the piston-ring/cylinder-liner tribological system are identified, as are materials that could potentially mitigate the wear problem. Many devices exist for materials screening, but none specifically addresses the dynamic interaction at high cyclical pressures and temperatures of the piston ring/cylinder liner with an abrasive containment in the interface. Simulation of these dynamic processes is a necessary step in solving the wear problem, although the first step must be to screen candidate materials using a device that would simply reciprocate flat specimens. Elimination of wear (other than by fuel modification) is found to depend on achieving adequate film thickness to prevent particulate contaminants from contacting the surfaces, as well as on developing surfaces substantially harder than the contaminants. A candidate wear-test device (based on a commercially available single-cylinder research engine) that would allow investigation of materials and lubrication schemes under representative engine conditions is recommended for further consideration. The device can be motored and pressurized to combustion conditions with nitrogen or ash introduced with the lubricant, or it can be motored with coal contaminants introduced into the cylinder by employing an external, low-pressure coal combustor. A similarity condition on lubricant film thickness is used to extrapolate the results to engines of different bore sizes.

41262 **(PB—87-179867/XAB) MEMEX: an expert system for vessel energy management. Executive Summary. Report for September 1985-January 1987.** Cooper, R.B.; Dickerson, D.J.; Selfridge, M.; Williams, K.E. (Ship Analytics, Inc., North Stonington, CT (USA)). Jan 1987. 13p. NTIS, PC A02/MF A01.

See also Final Report, PB—87-179875.

The report describes the development of a knowledge-based expert system, MEMEX, which reasons about problems related to energy management as they apply to the maintenance of medium speed marine diesel plants. The prototype demonstrator that was developed consists of three major components: (1) a knowledge base of rules, (2) an inferencing system, and (3) a natural language interface. The natural language interface is implemented employing a frame type architecture. Inputs by the user are simultaneously parsed for syntactic and semantic relationships. The conceptual dependencies processed are then used to access conceptual relationships embedded in the rules to initiate a consultation with the user. The intent is that the full MEMEX system would subsequently be installed aboard ships to assist engineers in maintaining high diesel engine plant operating efficiency. The report contains a User's Manual to aid in the operation of MEMEX; and a detailed description of issues relating to MEMEX development including selection of an application and selection of specific problems for the development of the knowledge base of rules.

41263 **(PB—87-179875/XAB) MEMEX: an expert system for vessel energy management. User's manual and final report. Report for September 1985-January 1987.** Cooper, R.B.; Dickerson, D.J.; Selfridge, M.; Williams, K.E. (Ship Analytics, Inc., North Stonington, CT (USA)). Jan 1987. 140p. NTIS, PC A07/MF A01.

See also Executive Summary, PB—87-179867.

The report summarizes the development of a knowledge-based expert system, MEMEX, which reasons about problems related to energy management as they apply to the maintenance of medium speed marine diesel plants. The prototype demonstrator

that was developed consists of three major components: (1) a knowledge base of rules, (2) an inferencing system, and (3) a natural language interface. The natural language interface is implemented employing a frame type architecture. Inputs by the user are simultaneously parsed for syntactic and semantic relationships. The conceptual dependencies processed are then used to access conceptual relationships embedded in the rules to initiate a consultation with the user. The intent is that the full MEMEX system would subsequently be installed aboard ships to assist engineers in maintaining high diesel engine plant operating efficiency. The project produced a User's Manual to aids in the operation of MEMEX; and a detailed description of issues relating to MEMEX development including selection of an application and selection of specific problems for the development of the knowledge based of rules.

3307 Emission Control

REFER ALSO TO CITATION(S) 41903

41264 **(PB—87-172375/XAB) Application for certification 1987 model year heavy-duty vehicles/engines.** (Environmental Protection Agency, Washington, DC (USA)). 1987. 2354p. NTIS, PC PC E99/MF E99.

Set includes PB—87-172383 through PB—87-172433.

41265 **(PB—87-172383/XAB) Application for certification 1987 model year heavy-duty vehicles - Chrysler Motors.** (Chrysler Corp., Detroit, MI (USA)). 1987. 523p. NTIS PC$57.00/MF$16.50.

See also PB—87-172391 and PB—87-141628; Also available in set of 6 reports PC E99/MF E99, PB—87-172375.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles, or heavy-duty engines submits to EPA an application for certification. In the application, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. These engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engines design, fuel systems, ignition systems and exhaust and evaporative emission control systems. They also provide information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. Section 16 of the application contains the results of emission testing, a statement of compliance to the regulations, production engine parameters, and a Summary Sheet Input Form on which issuance of a Certificate of Conformity is based.

41266 **(PB—87-172391/XAB) Application for certification 1987 model year heavy-duty vehicles/engines - Ford Motor Company.** (Ford Motor Co., Dearborn, MI (USA)). 1987. 602p. NTIS PC$63.50/MF$16.50.

See also PB—87-172383, PB—87-172409, and PB—86-176229; Also available in set of 6 reports PC E99/MF E99, PB—87-172375.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles, or heavy-duty duty engines submits to EPA an application for certification. In the application, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. These engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. They also provide information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. Section 16 of the application contains the results of emission testing, a statement of compliance to the regulations, production engine parameters, and a Summary Sheet Input Form on which issuance of a Certificate of Conformity is based.

41267 **(PB—87-172409/XAB) Application for certification 1987 model year heavy-duty vehicles/engines - General Motors Corporation.** (General Motors Proving Ground, Milford, MI (USA)). 1987. 352p. NTIS PC$43.50/MF$16.50.

See also PB—87-172391, PB—87-172417, and PB—86-176237; Also available in set of 6 reports PC E99/MF E99, PB—87-172375.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles, or heavy-duty engines submits to EPA an application for certification. In the application, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. These engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. They also provide information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing, a statement of compliance to the regulations, production engine parameters, and a Summary Sheet Input Form on which issuance of a Certificate of Conformity is based.

41268 **(PB—87-172417/XAB) Application for certification 1987 model year heavy-duty vehicles - Isuzu.** (Isuzu Motors America, Inc., Southfield, MI). 1987. 213p. NTIS PC$32.50/MF$16.50.

See also PB—87-172409, PB—87-172425, and PB—87-196303; Also available in set of 6 reports PC E99/MF E99, PB—87-172375.

Every year, each manufacturer of passenger cars, light-duty engines submits to EPA an application for certification. In the application, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. These engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. They also provide information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. Section 16 of the application contains the results of emission testing, a statement of compliance to the regulations, production engine parameters, and a Summary Sheet Input Form on which issuance of a Certificate of Conformity is based.

41269 **(PB—87-172425/XAB) Application for certification, 1987 model year heavy-duty engines - Mack trucks.** (Mack Trucks, Inc., Hagerstown, MD (USA)). 1987. 364p. NTIS PC$44.50/MF$16.50.

See also PB—87-172417, PB—87-172433, and PB—85-186393; Also available in set of 6 reports PC E99/MF E99, PB—87-172375.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles, or heavy-duty engines submits to EPA an application for certification. In the application, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. These engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. It also provides information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. Section 16 of the application contains the results of emission testing, a statement of compliance to the regulations, production engine parameters, and a Summary Sheet Input Form on which issuance of a Certificate of Conformity is based.

41270 **(PB—87-172433/XAB) Application for certification 1987 model year heavy-duty vehicles/engines - Mercedes-Benz Truck Company, Inc.** (Mercedes-Benz Truck Co., Inc., Charlotte, NC (USA)). 1987. 300p. NTIS PC$39.00/MF$16.50.

See also PB—87-172425, and PB—86-176278; Also available in set of 6 reports PC E99/MF E99, PB—87-172375.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles, or heavy-duty engines submits to EPA an application for certification. In the application, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. These engineering data include explanations and/or drawings which describe engine/vehi-

cle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. They also provide information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. Section 16 of the application contains the results of emission testing, a statement of compliance to the regulations, production engine parameters, and a Summary Sheet Input Form on which issuance of a Certificate of Conformity is based.

41271 **(PB—87-193678/XAB) Evaluation of techniques used in the preparation of diesel extract samples for mutagenicity studies.** Williams, R.; Perry, E.E.; Lewtas, J. (Environmental Health Research and Testing, Inc., Research Triangle Park, NC (USA)). 1986. 11p. NTIS, PC A02/MF A01.

Pub. in Environment International, Vol. 12, 625-633(1986).

Diesel-exhaust particles were used to compare methods and techniques used in the preparation of particulate samples for microbial mutagenesis testing. Investigated in the study were extraction, concentration, and solvent-exchange methodologies as they affected recovery of mutagenic material from diesel samples using a Salmonella typhimurium plate incorporation assay. Solvent-removal methods applicable for use in determining the mass concentration of extracts were also evaluated. Results indicated that particulate samples Soxhlet extracted with dichloromethane yielded higher levels of mutagenic activity than did comparative samples utilizing sonication. No difference was seen between rotary evaporation or Kuderna-Danish macro concentration of extracts to volumes greater than 50 ml.

41272 **(PB—87-194692/XAB) Heavy-duty engine testing report: correlation testing of Caterpillar 3208 DIT. Technical report.** Baines, T.M. (Environmental Protection Agency, Ann Arbor, MI (USA)). Feb 1987. 40p. (EPA/AA/SDSB—87/3). NTIS, PC A03/MF A01.

The report discusses the results of testing the Caterpillar 3208 DIT heavy-duty engine at the Environmental Protection Agency Motor Vehicle Emission Lab. The engine was tested for the purpose of providing correlation data to compare the EPA and Caterpillar laboratories. The engine, fuels, test procedures, and test plans are also discussed in the report.

3308 Alternative Fuels

REFER ALSO TO CITATION(S) 40457

41273 **(AFME—83-403) Experimentation of two low power alcohol engines, moteurgaro process.** Vaitilingam, G. (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1984. 86p. (In French). NTIS (US Sales Only), PC A05/MF A01. File Number DE87752533.

Developing countries need mechanical energy for agriculture development. Fuel is expensive in foreign currency. Some countries can produce ethanol at competitive price, from molasses for instance. The aim is to use this fuel in modified engines, for agricultural applications, by low income farmers. Two engines, modified by the Moteurgaro process, fuelled with ethanol 95 are tested in Mali and Reunion on small 25 HP tractors.

35 ARMS CONTROL

3501 Policy, Negotiations, And Legislation

REFER ALSO TO CITATION(S) 41866

41274 **(AD-A—180262/8/XAB) Gorbachev's arms-control strategy. Final report.** Nogee, J.L. (Houston Univ., TX (USA)). 22 Jan 1987. 25p. NTIS, PC A02/MF A01.

Presented at Soviet Military in the Year 2000, Conference Held in Newport, RI on 22 Jan 1987.

Soviet foreign policy under the Gorbachev administration, along with domestic policy, has been in a state of flux, particularly in the realm of arms-control policy. Both in substance and style, Gorbachev introduced a new dynamic in arms-control policy. He has skillfully manipulated the issue for propaganda appeal. But also he has shown flexibility in modifying Soviet positions both to respond to U.S. demands and to exert pressure on the United States to reach an agreement. Soviet arms-control objectives (some of which are incompatible) may be realized either through a formal agreement with the United States or without an agreement. These objectives include: (a) to use arms control to build a new framework for relations with the United States to replace detente; (b) to kill the Strategic Defense Initiative; (c) to constrain U.S. development in manned aircraft and cruise missiles (d) to deligitimize nuclear weapons as an instrument of military strategy; (e) to exacerbate differences between the United States and Europe. During his first year in power, Gorbachev relied heavily on propaganda with calls for eliminating nuclear weapons by the 21st century, his test ban moratorium and denunciation of SDI. After the 21st Party Congress he significantly modified Soviet positions closer to those of the United States with his acceptance of the zero option for INF forces, deep cuts in strategic weapons and willingness to accept limited research on SDI. Gorbachev now sees an arms control agreement as essential to his program for domestic reform and is prepared to make genuine concessions to achieve it.

41275 **(AD-A—180466/5/XAB) Deterrence enhanced by SDI (Strategic Defense Initiative). Student essay.** Sowa, P.T. (Army War Coll., Carlisle Barracks, PA (USA)). 23 Mar 1987. 46p. NTIS, PC A03/MF A01.

The Strategic Defense Initiative (SDI) is an investigation by scientists, military leaders, and technologists of the feasibility of strategic defenses against ballistic missiles. Whether strategic defense is the way to go in the future remains to be seen. Although the capability of the envisioned layered, ground, and space-based defensive systems is not specifically addressed, the SDI research program's affect on national-security strategy and its formulation is examined. If found to be feasible and cost-effective, SDI will require a drastic change in our military strategy. This essay reviews how that strategy was formulated in the past in terms of a model and how strategic-defense strategy would be used in the future. More importantly, a discussion of how the SDI impacts on present US national strategy and enhances deterrence is presented. Its influence on technology, conventional defense, and arms controls are offered on this evolving strategic concept and the renewed vigor and interest it has provided in strategy formulation.

41276 **(AD-A—180474/9/XAB) Effects of scientific, political, and allied opposition to SDI (Strategic Defense Initiative) on national security. Student essay.** McKie, F. (Army War Coll., Carlisle Barracks, PA (USA)). 23 Mar 1987. 32p. NTIS, PC A03/MF A01.

The Strategic Defense Initiative (SDI) is an intensive research program aimed at determining whether there are cost-effective defensive technologies that could enhance deterrence, strengthen stability, and increase the security of the United States and its allies against ballistic missile nuclear attack. Since its inception in March 1983, opposition to the SDI program has been widely publicized by the media. The most prominent sources of such opposition have been members of the scientific, political, and Allied communities. The sources and rationale for this opposition, along with effects on calibre of support for SDI research efforts, congressional funding, and program changes in the SDI research schedule were examined. Information was gathered through a review of the literature.

3502 Proliferation

REFER ALSO TO CITATION(S) 40665, 41865

41277 **(UCRL—96797) Emerging nuclear suppliers: What's the beef?.** Sands, A. (Lawrence Livermore National Lab., CA (USA)). 12 Jun 1987. Contract W-7405-ENG-48. 25p. (CONF-8706153—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE87011554.

From Emerging nuclear suppliers and nonproliferation conference; Bellagio, Italy (22 Jun 1987).

Countries perceived as potential nuclear proliferation threats have, in some cases, developed into potential nuclear exporters. These emerging nuclear exporters differ from traditional nuclear suppliers because they do not fully support the non-proliferation regime's suppliers' guidelines and are not well integrated into its norms and regulations. Although these new suppliers have limited technical capabilities, financial resources, and experience, they offer buyers certain attractions, such as access to restricted goods, fewer safeguards requirements, minimal end-use constraints, and even less cumbersome export licensing procedures. This paper explores the issue of emerging suppliers by trying to define who they are, why they exist and post a threat to non-proliferation efforts, and how possibly to respond to their challenge.

3503 Verification

41278 (CONF-870412—3) Statistical methods applied to treaty verification. DeVolpi, A. (Argonne National Lab., IL (USA)). 3 Mar 1987. Contract W-31109-ENG-38. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012207.

From General meeting of the American Physical Society; Crystal City, VA, USA (20 Apr 1987).

Arms-control treaties usually include provisions for verification that all parties are complying with the agreed-upon terms. The absence of specific or sufficient verification has led to well-publicized charges of non-compliance, particularly for treaties between the United States and the Soviet Union. An entirely new and better way of conducting verification is proposed based on statistical methods that make use of common scientific practices.

36 MATERIALS

41279 (DOE/ER/13626—1) Morphological aspects of surface reactions: Progress report, September 1, 1986-August 31, 1987. White, J.M. (Texas Univ., Austin (USA)). May 1987. Contract FG05-86ER13626. 3p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012470.

Studied were: grain structure of vapor-deposited Al on coated Cu TEM grids, catalytic properties of $Rh_6(CO)_{16}$ on silica, molecular orbital calculations for Rh compounds, and dissociative sticking probabilities of alkanes on Ni(100). (DLC)

41280 (HEDL-SA—3351) Preparation of TEM specimens from highly radioactive materials. McCarthy, J.M.; Thomas, L.E. (Hanford Engineering Development Lab., Richland, WA (USA)). Aug 1985. Contract AC06-76FF02170. 3p. (CONF-850840—20). San Francisco Press, Inc., Box 6800, San Francisco, CA 94101-6800. File Number TI87010420.

From Joint meeting of the Electron Microscopy Society of America and the Microbeam Analysis Society; Louisville, KY, USA (5 Aug 1985).

This paper describes a technique that yields ion-milled TEM specimens of reasonably low total activity from highly radioactive materials. Finished specimens each consist of a 3 mm diameter annular support ring that contains a small particle of sample, typically 50 to 300 μm in diameter and 5 to 10 μm in thickness, in epoxy. Although the application to nuclear materials is highly specialized, the basic preparation method requires only readily obtained materials, a simple grinding jig and an ion micromill for final specimen thinning.

3601 Metals And Alloys

REFER ALSO TO CITATION(S) 40346, 40543, 40546, 40552, 40578, 40591, 40592, 40595, 40603, 40624, 40625, 40626, 40627, 40628, 40629, 40630, 40631, 40632, 40684, 40784, 40786, 40788, 40829, 40830, 40833, 40836, 40850, 40851, 40852, 40852, 40853, 40853, 40855, 40856, 40860, 40860, 40863, 40878, 40878, 40919, 40920, 40921, 40921, 40926, 40962, 40962, 40981, 40989, 41066, 41394, 41663, 41674, 41909, 41920, 42660, 42661, 42661, 42671, 42672, 42673, 42686, 42688, 42691, 42697, 42798, 42829, 42829, 42831, 42842, 42843, 42844, 42844, 42845, 42847, 42857, 42858, 42859, 42860

41281 (AD-A—180200/8/XAB) Physical metallurgical basis for heat-affected zone and base-plate properties of a microalloyed HSLA steel. Final report 1984-1986. Nichting, R.A.; Brown, E.L. (Colorado School of Mines, Golden (USA). Dept. of Metallurgial Engineering). Dec 1986. 384p. (T—3136). NTIS, PC A17/MF A01.

The overall objective of this study was to elucidate the processing structure/property relationship associated with the heat-affected zone (HAZ) produced in an HSLA microalloyed steel during arc welding. Single-pass submerged arc welds on a Nb-V microalloyed steel were made with variable heat input. The thermal cycle as a function of heat input and position in the HAZ was determined experimentally in the course of welding. In addition, weld simulations were produced for selected heat inputs and HAZ locations. The evolution of austenite and transformation product microstructure as well as the state of microalloy precipitation was monitored as a function of heat input and HAZ location primarily via light and electron microscopy on specimens from actual welds and simulation specimens. These observations were utilized to support efforts to model austenite microstructure evolution and continuous-cooling transformation behavior in the HAZ. Charpy-impact-toughness testing was performed on actual weld HAZ specimens and specimens of selected simulation specimens. Impact transition curves were determined, and the microsctructure through which fracture propagated was correlated with impact transition energies and fracture surface morphology determined via scanning electron microscopy.

41282 (AD-A—180318/8/XAB) Preparation, characterization, and properties of rapidly solidified alloys. Progress report. Bendersky, L.; Shechtman, D.; Horowitz, E. (Johns Hopkins Univ., Baltimore, MD (USA). Dept. of Materials Science and Engineering). Oct 1986. 114p. NTIS, PC A06/MF A01.

The results obtained on six research projects undertaken within the framework of the DARPA/ONR sponsored research program on rapidly solidified alloys are reported in this progress report. Each of the six topics was prepared in the form of manuscripts that have been submitted and/or accepted for publication in a scientific journal. The manuscripts deal with microstructure Niobium/Silicon alloys), phase relationships of icosahedral alloys Aluminum/manganese alloys), microsegregation (silver/copper alloys), crystallization of the icosahedral phase (aluminum/manganese alloys), x-ray and electron studies of quasicrystals (Al-Mn-Si alloys), and phase equilibria studies (Al-Mn alloys). This research has contributed important data and concepts dealing with rapidly solidified alloy systems.

41283 (AD-A—180553/0/XAB) Studies of materials having significance for the production of high-energy magnets. Final report, 1 February 1984-31 January 1987. Wallace, W.E. (Carnegie-Mellon Univ., Pittsburgh, PA (USA)). 3 Apr 1987. 12p. NTIS, PC A02/MF A01.

Magnetic properties (saturation magnetizations, Curie temperatures and anisotropy fields of a number of rare earth-transition metal systems are reported. Systems studied fall into five categories: (1) 1:5 and 2:17 compounds, (2) R2T14B, where R is rare earth and T is a 3d transition metal, (3) borides related to R2Fe14B, 4) intermetallic hydrides, and (5) miscellaneous alloys. The work has revealed a number of interesting features of these systems: (a) when R in RCo5 systems is partially replaced by Ti, Zr or Hf, T sub c is sharply incremented; (b) PrCo8Fe9 has a theoretical (BH) sub max of 68 MGOe; (c) the R2T14B systems exhibit the same magnetic coupling systematics as the binary RT sub x systems; (d) the R2Fe14B systems exhibit the same magnetic coupling systematic

structures - conical, axial and planar anisotropy; (e) the RCo4B systems have small or negative anisotrophy and hence are unsuitable for magnetic fabrication; (f) hydrogenation weakens the uniaxial anisotrophy in R2Fe14B systems.

41284 **(CEA-CONF—8622) Mass transport in non crystalline metallic alloys.** Limoge, Y. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI)). Aug 1986. 6p. (CONF-8608158—2). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752251.

From Liquid and amorphous metals 6; Garmisch, Partenkirchen, F.R. Germany (25 Aug 1986).

In order to improve our understanding of mass transport in non crystalline metallic alloys we have developed indirect studies of diffusion based on electron irradiation and hydrostatic pressure effects upon crystallization. In a first part we present the models of crystallization which are used, then we give the experimental results. The main point is the first experimental measurement of the activation volume for diffusion in a metallic glass: the value of which is roughly one atomic volume. We show also recent quantitative results concerning radiation enhanced diffusion in metallic glasses (FeNi)/sub 8/(PB)/sub 2/ and Ni/sub 6/Nb/sub 4/. In a last part we discuss the atomic model needed to explain our results.

41285 **(CONF-860807—3) Temperture and composition dependence of the high flux plasma sputtering yield of Cu-Li binary alloys.** Krauss, A.R.; Mendelsohn, M.H.; Gruen, D.M.; Conn, R.W.; Goebel, D.M.; Hirooka, Y.; Leung, W.K.; Bohdansky, J. (Argonne National Lab., IL (USA); California Univ., Los Angeles (USA); Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). 1986. Contract W-31109-ENG-38. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011349.

From 6. international workshop on inelastic ion surface collisions; Argonne, IL, USA (25 Aug 1986).

High flux deuterium plasma sputtering and ion beam experiments have been performed on Cu-Li alloys to determine if the reduction in copper erosion previously predicted and observed in low flux ion beam experiments occurs at particle fluxes representative of an RFP first wall or tokamak limiter. Partial sputtering yields of the copper and lithium components have been measured as a function of alloy composition and sample temperature using optical plasma emission spectroscopy, weight loss and catcher foil techniques. It is found that the lithium sputtering yield increases with increasing sample temperature while the copper yield decreases by as much as two orders of magnitude. The temperature required to obtain the reduction in copper erosion is found to be a function of bulk lithium concentration. Consequences of these experimental results for anticipated erosion/redeposition properties are calculated, and the Cu-Li alloy in found to compare favorably with conventional low-Z materials.

41286 **(CONF-861207—112) The segregation of boron and its effect on the fracture of an Ni_3Si based alloy.** Oliver, W.C.; White, C.L. (Oak Ridge National Lab., TN (USA); Michigan Technological Univ., Houghton (USA). Dept. of Metallurgical Engineering). 1986. Contract AC05-84OR21400. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012533.

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

It is now well established that microalloying additions of B to Ni_3Al drastically reduce low temperature grain boundary fracture and consequently increase the ductility of this intermetallic compound. One possible explanation for such effects involves the relationship between boron segregation to grain boundaries and free surfaces, and the resulting effect of such segregation on the cohesive energy of the grain boundaries. This study involves the extension of these concepts to an alloy based on Ni_3Si. Auger spectroscopy has been carried out on fractured grain boundaries, grain interiors, and free surfaces to determine how B segregates in $Ni_3(Si,Ti)$. The consequences of the segregation of B on the cohesive energy of grain boundaries in Ni_3Si based alloys are discussed.

41287 **(CONF-870102—7) Effect of irradiation on the tensile properties of niobium-base alloys.** Grossbeck, M.L.; Heestand, R.L.; Atkin, S.D. (Oak Ridge National Lab., TN (USA); Hanford Engineering Development Lab., Richland, WA (USA)). Nov 1986. Contract AC05-84OR21400. 7p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87002409.

From 4. symposium on space nuclear power systems; Albuquerque, NM, USA (12 Jan 1987).

The alloys Nb-1Zr and PWC-11 (Nb-1Zr-0.1C) were selected as prime candidate alloys for the SP-100 reactor. Since the mechanical properties of niobium alloys irradiated to end-of-life exposure levels of about 2×10^{26} neutrons/m^2 ($E > 0.1$ MeV) at temperatures above 1300 K were not available, an irradiation experiment (B-350) in EBR-II was conducted. Irradiation creep, impact properties, bending fatigue, and tensile properties were investigated; however, only tensile properties will be reported in this paper. The tensile properties were studied since they easily reveal the common irradiation phenomena of hardening and embrittlement. Most attention was directed to testing at the irradiation temperature. Further testing was conducted at lower temperatures in order to scope the behavior of the alloys in cooldown conditions.

41288 **(CONF-870272—5) Surface magneto-optical studies of ferromagnetic films.** Bader, S.D.; Moog, E.R. (Argonne National Lab., IL (USA)). Feb 1987. Contract W-31109-ENG-38. 36p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011491.

From American Institute of Metallurgical Engineers annual meeting: light metals session; Denver, CO, USA (22 Feb 1987).

The magneto-optic Kerr effect is used to characterize the magnetic properties of epitaxial ferromagnetic films whose thickness includes the monolayer range. The studies are performed in ultra-high vacuum with LEED-Auger auxiliary characterizations to monitor the epitaxy and growth-mode behavior. Results are summarized for Fe deposited on Au(100) and Cu(100) to stabilize the bcc and fcc Fe phases, respectively. The most striking finding is the observation of a new, metastable ferromagnetic state at the surface of paramagnetic fcc-Fe/Cu(100) above room temperature. The observation is discussed in terms of a double minimum in the interlayer surface relaxation (with the expanded state being ferromagnetic and contracted state not) as supported by recent independent LEED measurements.

41289 **(CONF-870430—14) Analysis of long-lived isotopes by liquid scintillation spectrometry.** Bowers, D.L.; Greenwood, L.R. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011409.

From International conference on methods and applications of radioanalytical chemistry; Kona, HI, USA (5 Apr 1987).

Neutron production cross sections are reported for reactions leading to long-lived isotopes in fusion reactor materials. Pure elements and separated isotopes were irradiated with 14.6 to 14.8 MeV neutron fluences up to 10^{18} n/cm^2. Undesired activities were chemically separated and the long-lived activities were measured using both liquid scintillation and x-ray spectrometry. Results are presented for the reactions $^{56}Fe(n,2n)^{55}Fe$ (2.73 y), $^{64}Ni(n,2n)^{63}Ni$ (100 y), $^{63}Cu(n,P)^{63}Ni$, and $^{60}Ni(n,2n)^{59}Ni$ (76,000 y).

41290 **(CONF-870733—7) Phase transformations in aged CF 8 and CF 8M stainless steels.** Bentley, J.; Miller, M.K. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012522.

From Pacific workshop and meeting on analytical electron microscopy; Kona, HI, USA (12 Jul 1987).

The mechanical properties of CF 8 and CF 8M cast stainless steels used for the primary coolant pipes in pressurized light-water nuclear reactors (service temperature about 300°C) may be degraded by extended aging at 300 to 400°C. Of particular concern is the dramatic loss in impact properties to approximately 15% of the initial value. The cast steels have a duplex microstructure consisting of austenite (γ) with 15 to 20% δ-ferrite. The ferrite increases the yield strength and reduces the susceptibility to hot cracking. During aging, the ferrite decomposes spinodally into a fine scaled

interconnected network of iron-rich α phase and chromium-enriched α' phase. In addition, fine particles of G-phase, a complex silicide, are formed in the ferrite. In some cases, extensive carbide formation at γ-δ interfaces occurs. These fine scale phase transformations are believed to be responsible for the degradation of mechanical properties. This paper describes the results of microstructural analysis by atom-probe field-ion microscopy and analytical electron microscopy which provide a powerful combination for a complete characterization of these steels for reliable structure-property correlations.

41291 (CONF-870753—45) Superconductivity of A15-phase Nb/sub 3/Si synthesized by Mbar shock pressure. Neumeier, J.J.; Nellis, W.J.; Maple, M.B.; Torikachvili, M.S.; Sales, B.C. (California Univ., San Diego (USA); Lawrence Livermore National Lab., CA (USA); Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400;FG03-86ER45230. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012926.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

A15-phase Nb_3Si was synthesized by subjecting two 12 mm diameter and 1.5 mm thick discs of Nb_3Si in the majority phase of Ti_3P to Mbar shock pressures and quench rates up to 10^9 K/s and 10^{12}bar/s. Shock waves were generated by the LLNL two-stage light-gas gun. X-ray data indicate that a substantial portion of the A15 cubic phase was synthesized at the expense of the tetragonal phase of the starting specimen. The occurrence of superconductivity in these specimens was determined by measurements of electrical resistivity and ac magnetic susceptibility, chi/sub ac/, onsets of superconductivity are 17.8 K.

41292 (CONF-8705103—9) Development of creep resistant austenitic stainless steels for advanced steam cycle superheater application. Maziasz, P.J.; Swindeman, R.W. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 29p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87012929.

From Fossil energy materials program conference; Oak Ridge, TN, USA (19 May 1987).

The compositions of several 14Cr-16Ni austenitic stainless steels were modified with combinations of minor and residual alloying elements to produce excellent creep strength based on unique precipitate microstructures. These modifications produce fine MC and phosphide precipitates in the matrix for strength and various coarser carbide phases along the grain boundaries for ductility and rupture resistance. Creep-rupture resistance of these modified 14-16 steels is much better than that of type 316 or Inconel 800H and better than that of 17-14CuMo at 700°C in the mill-annealed condition. Analysis of microstructure and correlation with creep properties suggests that precipitate effects are primarily responsible for the properties improvement. The ideas and insight for design of the novel precipitate microstructures stem from microcompositional information obtained using state-of-the-art analytical electron microscopy (AEM). 5 refs., 13 figs., 1 tab.

41293 (CONF-8706159—1) Ion scattering study of the W(001)-(5x1)-C surface. Overbury, S.H.; Mullins, D.R. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 13p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87011650.

From 2. international conference on the structure of surfaces; Amsterdam, Netherlands (22 Jun 1987).

We have examined the structure of the carburized W(001) surface by incident angle dependent aikali ion scattering and find that the surface is not reconstructed to the quasi-hexagonal structure previously proposed. Instead, the p(5x1) LEED pattern is attributed principally to an ordered C overlayer.

41294 (CONF-8706159—3) Atomic structure of three low-index surfaces of the ordered binary alloy NiAl. Davis, H.L.; Noonan, J.R. (Oak Ridge National Lab., TN (USA)). Jun 1987. Contract AC05-84OR21400. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011670.

From 2. international conference on the structure of surfaces; Amsterdam, Netherlands (22 Jun 1987).

The atomic structures of the (110), (100), and (111) surfaces of NiAl have been determined by LEED I-V analysis. Results obtained for these surfaces serve as illustrations of three general crystallographic effects that can exist in the surfaces of ordered alloys. The three effects are the rippling of atomic constituents in the outermost composite layer of NiAl(110), preferential termination by one of two possible layers at the NiAl(100) surface, and the mixture of domains of the two possible terminations at the NiAl(111) surface.

41295 (DOE/ER/45297—3) Fabrication and future of metallic superlattices. Falco, C.M. (Arizona Univ., Tucson (USA)). 1987. Contract FG02-87ER45297. 9p. (CONF-870761—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012726.

From 3. international conference on modulated semiconductor structure; Montpelier, France (6 Jul 1987).

Research on metallic multilayers and superlattices is reviewed. The types of layered structures of interest for metals is described. The principal techniques used to prepare these materials are described, and examples of applications are given.

41296 (DOE/ER/45310—1) Dislocation structure and energy of high angle [001] twist boundaries: A computer simulation study. Schwartz, D.; Bristowe, P.D.; Vitek, V. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Materials Science and Engineering; Pennsylvania Univ., Philadelphia (USA). Dept. of Materials Science and Engineering). Jun 1987. Contract FG02-84ER45116;FG02-87ER45310. 42p. NTIS, PC A03. File Number DE87012745.

High angle (001) twist boundaries have been frequently investigated experimentally and the presence of grain boundary dislocations (gbd's) and associated cusps in the dependence of the boundary energy on misorientation, is in this case well established. However, in previous computer simulations of these boundaries neither localized gbd's nor distinct energy cusps have been identified. Aim of the present study is to clarify this discrepancy between observations and computer modelling. For this purpose the structure and energy of a number of long period (high Σ) twist boundaries with misorientations very close to $\Sigma = 5$ have been calculated using empirical pair and n-body potentials to describe interatomic forces. Furthermore, an isolated gbd embedded into an $\Sigma = 5$ boundary has been modeled. Well-defined cusps at $\Sigma = 5$ misorientation and localized gbd's have been found but the reference $\Sigma = 5$ structure is always the lowest energy structure which, in general, does not possess the symmetry of the coincidence site lattice. The misorientation dependence of the boundary energy is then discussed using a Read-Shockley type model. The cusps are always very shallow and may have an unconventional shape which is related to the dependence of the elastic energy on misorientation that is not the same for twist and tilt boundaries, contrary to what is usually assumed. Finally, some remaining discrepancies between observed types of gbd's and those found in the present study are discussed in the light of the previously proposed multiplicities of boundary structures.

41297 (DP—1748) Weldability of general purpose heat source new process iridium. Kanne, W.R. (Savannah River Lab., Aiken, SC (USA)). May 1987. Contract AC09-76SR00001. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012848.

Weldability test results show that iridium produced by the new Oak Ridge National Laboratory (ORNL) process is less susceptible to cracking than old process iridium. Seventeen capsules were welded (for a total of 255 welds) in four categories, and the number of cracks in the welds was counted as the criterion for weldability. Results also indicate that the 1500°C iridium shell heat treatment at Mound Facility has little effect on weld cracking. Long weld quenches had fewer cracks than did short quenches, confirming that the present production procedure is the preferred procedure. Ultrasonic test indications were confirmed to be either cracks or other defects. Metallographic examination showed the metallurgical structure of the welds to be typical and unaffected by the category of material.

41298 **(EIR—615) Study of the mechanical property changes of irradiation embrittled pressure vessel steels and their response to annealing treatments.** Tipping, P.; Waeber, W.B.; Mercier, O. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). Mar 1987. 13p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702558.

Isochronal and isothermal heat treatments have been used to study the recovery of hardness of an irradiated pressure vessel steel forging for purposes of planning and realizing IAR (Irradiated-Annealed-Reirradiated) experiments. Charpy V notch tests have been performed to assess the toughness of the material irradiated to various fluences up to a maximum of $5x10^{19}$ n/cm^2, E > 1 MeV at 290 degrees C with and without an intermediate annealing treatment at 450Cx168h. The effect of the intermediate annealing was evident. The recovery of the upper shelf energies was strongly enhanced by a thermal aging effect due to the annealing treatment for all fluence levels investigated compared to the irradiated condition. The transition temperature shifts exhibited a less straight forward behaviour due to the mentioned aging effect which opposed the recovery process for this property leading to a net shift increase at lower and to a net recovery benefit at higher fluence levels. A phenomenological model description for the IAR embrittlement-recovery path is suggested. For this material and these irradiation conditions a plant life extension (PLEX) may be brought about if a specific annealing treatment is applied at a fluence level that is half the anticipated target fluence F for PLEX. In this case it was found that F > $1.6x10^{19}$ n/cm^2.

41299 **(EIR—617) Temperature dependence of the dynamic fracture toughness and the specific impact energies of the alloy Nimonic 86 in the temperature range 293 < T/K < 1223.** Krompholz, K.; Ullrich, G. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). Apr 1987. 42p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87702559.

Precracked Charpy V-notch specimens of the nickel base alloy Nimonic 86 in the as-received condition have been tested using an instrumented impact tester (hammer) in the temperature range 293 < T/K < 1223. The specific impact energies were determined by dial readings from the maximum angle of the afterswing after the impact, from the integration of the load versus time and the load versus load point displacement diagrams; in all cases the agreement was excellent. The specific impact energy and the impulse are correlated with the test temperature. The dynamic fracture toughness values were determined following the equivalent energy approach. While the temperature dependency of the specific impact energies and the impulses reveal a distinct maximum at T = 773 K (500 degrees C) no such maximum in the temperature dependence of the dynamic fracture toughness was observed. The fracture surfaces show distinct elasto-plastic fracture behaviour of the material in the temperature regime investigated.

41300 **(EPRI-NP—5129) Mechanisms of intergranular attack and stress corrosion cracking of Alloy 600 by high-temperature caustic solutions containing impurities: Final report.** Van Rooyen, D.; Bandy, R. (Brookhaven National Lab., Upton, NY (USA); California State Univ., Sacramento (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jul 1987. Contract AC02-76CH00016. 188p. NTIS, PC A09/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303; 1; GPO Dep. File Number DE87012820.

The mechanisms of intergranular attack (IGA) and intergranular stress corrosion cracking (SCC) of Alloy 600 are investigated in high temperature sodium hydroxide environments contaminated with impurities such as carbonate, sulfate, silicate, magnetite, and chromic oxide. Results show that caustic alone can cause both IGA and SCC. The effects of electrochemical potential, stress, time, temperature and the metallurgical state of Alloy 600 on the IGA and SCC are discussed. It appears that both IGA and SCC are manifestations of a general intergranular failure process. In the presence of adverse potential, stress, strain rate and temperature, the slower IGA process is generally replaced by the faster SCC process.

41301 **(EUR—9161) Metallurgical and mechanical parameters of steel hydrogen embrittlement. Basic study: parameter search, understanding of their action. Industrial applications: Hydrogen standard elaboration, verifications to recommend. Vol. 1.** Pressouyre, G.M.; Zmudzinski, C. (Commission of the European Communities, Luxembourg). 1984. 94p. (In French). NTIS (US Sales Only), PC A05/MF A01. File Number DE87752538.

This study makes use of the last fundamental concepts on Hydrogen Embrittlement, HE, to try to understand and resist better this phenomenon. Three different steel grades have been studied: C-Mn steels, 3.5 Ni steel and 2.25/3 Cr steels. Laboratory heats have been developed so as to study particular groups of HE parameters: inclusions, segregations, added traps, mechanical characteristics. Industrial heats have been looked at to verify some results obtained on lab heats (e.g. results on sulfur influence in C-Mn steels), and to develop statistics (on chemical composition in the 3.5 Ni case, e.g.). Many techniques have been used: F % test, disk rupture test, fracture mechanics, progressive cracking techniques, permeation and mass spectrometry, electronic microscopy... Among the most important findings: 1) the noxious role of non-metallic inclusions is put forth; 2) the importance of microstructures and related heat treatments is confirmed: 3) the beneficial role of correct trap additions is shown in some cases, the noxious role of others too; 4) the choice of a given test technique is fundamental in appreciating a steel's susceptibility to HE. Practical rules are given concerning the steelmaking and use in hydrogen of the steels studied.

41302 **(EUR—10522) Corrosion of low carbon steel in clay and sea sediments.** Lanza, F.; Ronsecco, C. (Commission of the European Communities, Ispra (Italy). Joint Research Centre; Commission of the European Communities, Luxembourg). 1986. 30p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87752268.

A series of corrosion test have been conducted putting in contact mild steel samples with clay and two types of sea sediments. The test have been performed at 30, 50 and 90/sup 0/C up to a maximum duration time of 220 days. As the tests were performed in a closed system, most of the corrosion arrived in anoxic conditions. After an initial stabilization period corrosion weight losses increase linearly with time. The long term corrosion rate in presence of carbonaceous sediments is significantly higher than that obtained in clay or clay rich sediments. An analysis of the ion diffused in the porous media has shown that all the iron which is corroded in the anoxic condition is released in a soluble form. 11 refs.

41303 **(GKSS—87/E/5) Prediction of instability using the K/sub R/-curve approach.** McCabe, D.E.; Schwalbe, K.H. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.); Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center). 1987. 17p. NTIS, PC E07; Available from NTIS as TIB/B87-09402.

An elastic-plastic R-curve instability prediction method is reported. The method is prepared in a format such that the computational steps outlined can be used as a guide to make instability predictions. Three example problems are given.

41304 **(GKSS—87/E/6) Monitoring stable crack growth using a combined a.c./d.c. potential drop technique.** Dietzel, W.; Schwalbe, K.H. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.)). 1987. 7p. NTIS, PC E07; Available from NTIS as TIB/B87-09401.

Although these techniques usually are regarded as being alternative methods, tests on CT specimens of an RPV steel (20MnMoNi55) were performed in order to find out to what extent a combination of both might be a useful tool for studying crack initiation and propagation in fracture mechanics tests. Results obtained so far indicate that a combined a.c./d.c. potential drop measuring technique in some cases can help in obtaining more information from a single test in particular for the onset of stable crack growth.

41305 **(GKSS—87/E/7) On the determination of crack initiation using standard test methods.** Hellmann, D.; Schwalbe, K.H. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.); GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Werkstofftechnologie und Chemie). 1987. 8p. NTIS, PC E07; Available from NTIS as TIB/B87-09400.

The results presented in this paper were obtained by participation in an ASTM experimental round-robin exercise. The round-robin was aimed at verifying the appropriateness of ASTM Draft Test Method for Crack Tip Opening Displacement (CTOD) Testing. It was demonstrated that the Draft Method is suitable for determining initiation values of CTOD and that more unequivocal values are obtained if the crack length is measured as the average of ten instead of three individual values distributed over the specimen thickness. This is consistent with the recent revision of the Draft Method.

41306 **(HEDL-SA—3548) In-reactor creep rupture behavior of the D9 alloys.** Puigh, R.J.; Hamilton, M.L. (Hanford Engineering Development Lab., Richland, WA (USA)). Jun 1986. Contract AC06-76FF02170. 15p. (CONF-860605—44). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011480.

From 13. international symposium on the effects of radiation on materials; Seattle, WA, USA (23 Jun 1986).

The uncertainties in the in-reactor stress rupture data have been significantly reduced with the acquisition of the Materials Open Test Assembly (MOTA) for testing of materials in the Fast Flux Test Facility (FFTF). The temperature uncertainty associated with irradiation in this vehicle is +- 5°C. Moreover, through the use of tag gases and an on-line cover gas monitoring system, on-line detection of specimen ruptures is possible during irradiation, thereby significantly reducing the uncertainty associated with the rupture times. Titanium additions, increases in nickel content and decreases in chromium content, which were made to improve the swelling response of 316 SS, resulted in an alloy class referred to as "D9". In-reactor stress rupture data from the MOTA experiment have been reported on two conditions of the D9-type alloys for exposure times corresponding to 2,400 hours at irradiation temperatures of 575, 605, 670, and 750°C. For these conditions the in-reactor rupture times were similar to those observed in thermal control tests. This report will describe both the in-reactor stress rupture behavior and the thermal control data for 20% cold work (CW) 316 SS and for 10 and 20% CW D9-type alloy over a similar temperature range for in-reactor exposure times corresponding to 13170 hr. and peak fast fluences corresponding to 17 x 10^{22} n/cm^2 (E > 0.1 MeV).

41307 **(HMI-B—433) Monte Carlo calculations for the simulation of channeling experiments on irradiated aluminium alloys. Calculation of angle-dependent yield curves.** Mueller, M. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (Germany, F.R.). Bereich Kernchemie und Reaktor). Aug 1986. 110p. (In German). NTIS, PC E11; Available from NTIS as TIB/B87-07812.

One of the most useful application of the channeling technique is the location of solute atoms in irradiation produced mixed dumbbells of aluminium alloys. Therefore here the channeling process is simulated on the basis of Monte Carlo calculations regarding the collisions of the channeled He ions with the nearest target atom in momentum approximation. Flux distributions are determined as a function of the angle of incidence. The report contains 81 figures each of which represents <100>, <110>, and <111> axial as well as {100}, {110}, and {111} planar angular yields of He ions backscattered from solute atoms in mixed dumbbells of different concentrations. The solute atom is assumed to be displaced from the lattice site in <100>, <110>, or <111> direction. On the basis of these curves the positions of the Mn, Ag, Cu, Ge, and Zn atoms in mixed dumbbells of aluminium alloys could be determined from experimental scans.

41308 **(INIS-BR—670) Influence of niobium and molybdenum in austenitic stainless steel related to oxidation and corrosion.** Quinelato, A.A.; Rollo, J.M.D.A.; Casteletti, L.C. (Centro de Tecnologia Educacional para Engenharia, Sao Paulo (Brazil)). 1985. 1p. (In Portuguese). (CONF-8512129—2-Summ.). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702778.

From 4. congress of scientific and technological engineering; Sao Carlos, Brazil (1 Dec 1985).

Published in summary form only.

41309 **(INIS-BR—673) Stabilization of zirconium.** Onodera, E.; Souza, D.P.F.; Casarini, J.R. (Centro de Tecnologia Educacional para Engenharia, Sao Paulo (Brazil)). 1985. 1p. (In Portuguese). (CONF-8512129—4-Summ.). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702780.

From 4. congress of scientific and technological engineering; Sao Carlos, Brazil (1 Dec 1985).

Published in summary form only.

41310 **(INIS-mf—10671) Influence of temperature and loading rate on elastic-plastic fracture at ductile-brittle transition. Technical report.** Packeiser, R.; Ziebs, J.; Helms, R.; Aurich, D. (Bundesanstalt fuer Materialpruefung, Berlin (Germany, F.R.)). 22 Sep 1986. 26p. (In German). NTIS, PC E07; Available from NTIS as TIB/B87-08703.

This subproject is concerned with the influence of temperature and loading rate on elastic-plastic fracture in the range of ductile-brittle transition. Side grooved three point bend specimens of a width of 200 mm and a thickness of 100 mm, made out of two steels of the type 20 NiMoCr 37 (St. 1.6751) of different toughness, have been loaded with two deflection rates differing by a factor of 10/sup 5/ in the range between initiation and upper shelf temperature. Due to dynamical loading the transition temperature of these steels has been increased by about 30 K. The slope of the crack resistance curve of the steel of lower toughness was increased considerable due to dynamical loading whereas the slope of the crack resistance curve of the steel of high toughness was increased only negligible. The results suggest that a conservative assessment of dynamically loaded components may be based on quasi-static crack resistance curves. However, in the case of dynamical loading stable crack growth can be supposed only at temperatures being considerable higher than for quasi-static loading.

41311 **(JAERI-M—86-139) Neutron irradiation effects at cryogenic temperature on the structural materials for cold neutron source.** Kawabata, Y.; Takahashi, H. (Japan Atomic Energy Research Inst., Tokyo). Sep 1986. 77p. (In Japanese). NTIS (US Sales Only), PC A05/MF A01. File Number DE87702622.

In recent years, the demand on cold neutron is growing in the neutron scattering research. According to such requirements the cold neutron source (CNS) is planned for the upgraded JRR-3. The moderator cell in CNS, which contains liquid hydrogen, will be irradiated for long time by high fluence in the deuterium reflector region. The moderator cell has to endure quite wide range of temperature from the liquid hydrogen temperature (about 20 K) to high temperature (about 400 deg C). Therefore the moderator cell, with quite thin thickness and ovoid shape to moderate and draw out neutrons effectively, must have so high mechanical strength as to keep liquid hydrogen in the severe conditions. In this report, the mechanical tests on the materials for the moderator cell after the irradiation in the cryogenic temperature are reviewed, and the mechanical strength of the materials for moderator cell are discussed. It is shown that A286 is the best material for the moderator cell, and it will keep enough strength during the operational period of the cold neutron source installed in the upgraded JRR-3.

41312 **(JAERI-M—86-181) Magnetic characteristics of ferromagnetic stainless steels, SUS 403, SUS 410J1, TAF and SUS 405.** Ara, K.; Yamada, M.; Kakuta, T.; Yamagishi, H. (Japan Atomic Energy Research Inst., Tokyo). Dec 1986. 99p. NTIS (US Sales Only), PC A05/MF A01. File Number DE87702647.

Ferromagnetic stainless steels have been used in magnetic and electro-magnetic devices which are exposed to severe environments such as an incore of nuclear reactor. Wide use of these materials is naturally due to their ferromagnetism, and also due to their excellent properties in corrosion, radiation and heat resistances. Easy machining process at a low cost and good availability in the market are counted for them as another advantage. However, their magnetic properties are not well established in a standard form as refered in handbooks, because they are originally developed as a structure material. This situation, the lack of sufficient data, leads us to study the magnetic properties of the martensitic stainless steels, SUS 403, SUS 410J1 and TAF, and the ferritic stainless steel, SUS 405, in connection with the development of incore instruments. The magnetic properties were measured for many specimens after various heat treatments such as quenching and tempering, low temperature annealing and full annealing. Temperature dependence of magnetic properties was measured with an electric furnace. Magnetic properties measured in this study were of initial magnetization, dc hysteresis, ac permeability and inverse magnetostriction, and Curie point as well. The martensitic stainless steels show somewhat semi-hard characteristics (Hc; 5 - 15 oersteds) and the ferritic stainless steel is rather soft (Hc; 2 - 5 oersteds). The Curie points range from 720 to 750 deg C. The saturation magnetization is about 15000 gausses. The large inverse magnetostriction is observed in SUS 403 and SUS 405, and this may be utilized in acoustic and sonic application as well as in force and pressure measurements. Because the magnetic properties depend on the heat treatments, the optimum condition of heat treatment may be chosen so as to satisfy requirements to the magnetic characteristics.

41313 **(JINR—14-86-409) Heavy ion and neutron irradiation effect on vanadium alloys behaviour during post-irradiation annealing.** Gomozov, L.I.; Votinov, S.N.; Didyk, A.Yu. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1986. 7p. (In Russian). (CONF-8606325—1). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702820.

From 4. All-Union conference on radiative defects in metals; Alma-Ata, USSR (1 Jun 1986).

The mechanical properties of model vanadium alloys irradiated by neutrons and heavy ions are investigated as a function of the post-irradiation annealing temperature by using the microhardness technique. It is shown that neutron irradiation leads to nearly the same change in microhardness as ion dose, but in the former case the radiation-annealing hardening effect is weaker by about 15-20%. The radiation and radiation-annealing hardening degree of vanadium alloys irradiated at a temperature of less than 0.3 T/sub m/ are determined by the influence of alloying substitutional impurity on the aging degree due to interstitials. 7 refs.; 3 figs.; 3 tabs.

41314 **(JINR—14-86-410) Radiation hardening of nickel and vanadium irradiated by heavy ions with 1 MeV/a.m.u. energy.** Didyk, A.Yu.; Kuznetsov, V.I.; Skuratov, V.A.; Shestakov, V.D.; Regel', V.R. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1986. 6p. (In Russian). (CONF-8606325—2). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702821.

From 4. All-Union conference on radiative defects in metals; Alma-Ata, USSR (1 Jun 1986).

The hardening of nickel and vanadium irradiated by Ne, Ar, Xe ions with 1 MeV/a.m.u. energy is investigated using the microhardness technique. The damage dose dependence of radiation hardening is determined in the 10/sup -5/-5 x 10/sup -1/ dpa region. It is shown that radiation hardening depends on the "stiffness" of the primary-knock atom spectrum. 7 refs.; 4 figs.

41315 **(KU-HCOE-FL2-R—86-05) Effect of boron implantation on the corrosion behaviour, microhardness and contact resistance of copper and silver surfaces.** Henriksen, O.; Johnson, E.; Johansen, A.; Sarholt-Kristensen, L. (Copenhagen Univ. (Denmark). H.C. Oersted Inst.). 1986. 21p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87752329.

In order to investigate the influence of boron implantation on the corrosion resistance of electrical contacts, a number of pure copper, pure silver and copper edge connector samples have been implanted with boron (40 keV) to fluences of 5.10/sup 20/ m/sup -2/ and 2.10/sup 21/ m/sup -2/. Atmospheric corrosion tests of the implanted species were conducted using the following exposures: H/sub 2/S (12.5 ppm, 4 days), SO/sub 2/ (25 ppm, 21 days), saltfog (5% NaCl, 1 day), moist air (93% RH, 56 days), and hot/dry air (70 C, 56 days). The boron implantations lead to a significant reduction in the sulphidation rate of copper and silver. The corrosive film formed during exposure in H/sub 2/S and SO/sub 2/ atmospheres is confined to pitted regions on the implanted areas, while a thick and relatively uniform film formation is observed on the unimplanted samples. The corrosion resistance of copper and silver in saltfog atmosphere is somewhat improved by boron implantation, whilst the resuits from exposures to moist air or hot/dry air are inconclusive. The improved corrosion behaviour is accompanied by an increase in the contact resistance and in the microhardness of the implanted samples.

41316 **(KU-HCOE-FL2-R—86-13) Microstructure of rapidly solidified and ion implanted stainless steels.** Elvidge, C.; Wood, J.V.; Graabaek, L.; Johnson, E.; Johansen, A.; Sarholt-Kristensen, L. (Copenhagen Univ. (Denmark). H.C. Oersted Inst.). 1986. 9p. (CONF-861063—5). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752335.

From American Society of Metals materials week; Lake Buena Vista, FL, USA (6 Oct 1986).

Series of Fe-Cr and Fe-Ni-Cr-C steels have been processed by rapid solidification and subsequently amorphised by ion implantation. Rapid solidification results in a fine grained structure leading to a supression of the M/sub s/ (martensite start) temperature in all cases. By contrast, ion implantation of similar steels raises the M/sub s/ temperature as a consequence of the high stress levels attained. Rapid solidification of these alloys does not lead to amorphisation unless at least 12 at.% metalloid is present. This contrasts significantly with the low fluences of phosphorus (10/sup 20/ m/sup -2/) that are necessary for the onset of amorphisation by implantation.

41317 **(LA-UR—87-2284) Ti-6%Al-4%V alloy wave profile measurements in the shadow region.** Morris, C.E.; Winkler, M.A.; Mitchell, A.C. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 5p. (CONF-870753—48). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013142.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

VISAR wave profile measurements were made on the Ti-6%Al-4%V alloy to elucidate why the Hugoniot does not extrapolate through the bulk sound speed at zero pressure. Symmetric impact experiments were performed on targets with LiF windows in the shadow region ($P < 40$ GPa). Large elastic waves (2.8 GPa) were observed that appeared to shock-up. The low pressure Hugoniot is given by /sup 1/U/sub s/ = 5.123 km/s + 1.083 U/sub p/ for U/sub p/ < 1.4 km/s. No phase transformations were observed in this region.

41318 **(LA-UR—87-2366) A simulation study of interfaces in Ni, Al, and Ni_3Al with and without boron.** Chen, S.P.; Voter, A.F.; Srolovitz, D.J. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 8p. (CONF-870793—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013156.

From Conference on interface science and engineering; Lake Placid, NY, USA (12 Jul 1987).

Atomistic simulations of free surfaces and [001] symmetric tilt grain boundaries in pure Ni and Al and the intermetallic, Ni_3Al, are presented. In the vicinity of the grain boundary, we show the existence of a rapidly decaying oscillatory strain which is similar to that observed at free surfaces. The total expansion or excess volume associated with the grain boundary is shown to be proportional to the grain boundary energy. The atomistic structures of the simulated grain boundaries have been analyzed in terms of the structural unit model, which is found to be of limited utility in the case of the intermetallic. Preliminary results show that boron segregates more strongly to grain boundaries than to free surfaces. Boron segregation strengthens the grain boundary but has little effect on grain boundary structure other than a small local expansion.

41319 **(LA-UR—87-2449) Using rapid solidification processing to produce microstructures with optimum properties.** Martin, P.L.; Williams, J.C. (Los Alamos National Lab., NM (USA); Carnegie-Mellon Univ., Pittsburgh, PA (USA)). 1986. Contract W-7405-ENG-36. 11p. (CONF-861257—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013161.

From 4. rapid solidification conference; Santa Barbara, CA, USA (14 Dec 1986).

Rapid Solidification Processing (RSP) permits an additional degree of freedom for tailoring the microstructure of materials. As a result, microstructures can be controlled to a degree which has not been consistently achieved by ingot metallurgy methods. This capability provides an opportunity to optimize a particular property or set of properties. When the choices of microstructure are required to make up front, it turns out that the bases for making them are often not well-founded in fundamentals. In this paper we review the principles for selecting microstructures and attempt to identify those areas where our understanding is incomplete. We also discuss some cases where these microstructural choices can be made and some where they cannot. Further, we describe some specific examples of alloy systems where RSP has been used successfully to tailor properties. Finally, we attempt to assess the potential for extending these techniques to other alloy systems and to define some of the current limitations which are associated with RSP. This discussion permits identification of those areas where additional research on processing-microstructure and microstructure-property relations is indicated. 27 refs.

41320 **(LBL—23535) Strain controlled morphologies in the two-phase state.** Khachaturyan, A.G. (Lawrence Berkeley Lab., CA (USA)). Jun 1987. Contract AC03-76SF00098. 48p. (CONF-8706103—4). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87012888.

From NATO advanced study institute on alloy phase stability; Crete, Greece (14 Jun 1987).

The main topic of this lecture is the discussion of the application of the elastic theory to practical problems which arise in structural studies of the morphology of two-phase alloys. The consideration is based on the theory developed for the homogeneous modulus case because this approach enables one to treat arbitrary dispersoids using very simple mathematics. The cases where this approximation turns out to be insufficient are discussed. The applied aspects of the theory are especially emphasized. There are three groups of problems discussed in detail: morphology of a single coherent precipitate, its habit plane, equilibrium shape, orientational relations and crystal lattice parameters in the constraint state; shape transformations and morphology instabilities upon coarsening; and strain-induced rearrangement of groups of precipitates upon coarsening.

41321 **(LBL—23537) The structures of CO, NO and benzene on various transition metal surfaces: Overview of LEED [low-energy electron diffraction] and HREELS [high-resolution electron energy loss] results.** Ohtani, H.; Van Hove, M.A.; Somorjai, G.A. (Lawrence Berkeley Lab., CA (USA)). Jun 1987. Contract AC03-76SF00098. 8p. (CONF-8706159—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012891.

From 2. international conference on the structure of surfaces; Amsterdam, Netherlands (22 Jun 1987).

Recent results are summarized concerning the adsorption structures of carbon monoxide (CO) and nitric oxide (NO) chemisorbed on various transition metal surfaces, and of benzene (C_6H_6) on Pd, Rh and Pt(111). These results were for the most part obtained with intensity analysis of low-energy electron diffraction (LEED) and high-resolution electron energy loss spectroscopy (HREELS).

41322 **(NAGRA-NTB—84-32) Assessment of the corrosion resistance of the high-level waste containers proposed by Nagra.** (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Dec 1984. 37p. Nagra, CH-5401 Baden, Switzerland.

The Nagra concept for the final disposal of high-level radioactive waste includes a container ensuring isolation of the waste from the groundwater for a period of time of at least 1000 years. Two types of containers are proposed by Nagra in current feasibility projects: the first type, for reprocessed vitrified waste is designed as a self-supporting shell; the material is cast steel GS-40. The second type, for spent fuel, is an adaptation of Swedish designs in which the spent fuel elements are cast in lead inside a thick-walled copper container. The assessment of the corrosion resistance of these containers is based on the conditions expected in a repository in the crystalline bedrock of northern Switzerland. The groundwater is reducing, with salinity up to seawater level and a high sulphate content. Under these conditions the only significant contributions to the corrosion of copper come from residual oxygen trapped in the bentonite used as backfill material and from sulphate, if it is assumed that the latter can be reduced to sulphide by microbial activity. This is certainly a very conservative assumption, since it implies that sufficient populations of appropriate bacteria can be supported under repository conditions, but it cannot be ruled out on present-day evidence. The use of this together with other conservative assumptions leads to the conclusion that the maximum penetration by corrosion will not exceed 40 mm in 1000 years. For iron the same mechanisms must be considered; a maximum penetration of less than 30 mm in 1000 years is obtained.

41323 **(NIIAR—22(703)) Preparation and investigation of microquantities of lanthanoids and their intermetallides.** Ryabinin, M.A.; Radchenko, V.M.; Lebedeva, L.S.; Shushakova, V.D.; Seleznev, A.G.; Droznik, R.R.; Vasil'ev, V.Ya. (Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Dimitrovgrad (USSR)). 1986. 23p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702846.

Complex equipment, designed for preparation of pure rare earth and actinoid metals (about 1 mg), their solid compounds (intermetallides and alloys) to investigate thermal stability in vacuum, inert and oxidizing atmosphere at temperatures up to 2000 deg C, is described. The first experimental data on thermal stability of Pt_5Sm, Pt_5Gd intermetallides in vacuum, as well as the results of preparation of milligram quantities of metallic samarium, neodymium and dysprosium by the method lanthan- and thorium-thermal reduction of their oxides are given. These data were the methodical base for preparation of metallic berkelium and californium, for investigation of intermetallides and alloys of actinoid elements with noble metals. 14 references, 5 figures, 4 tables.

41324 **(SAND—86-2219C) The role of the metal vapor plume in pulsed Nd:YAG laser welding on aluminum 1100.** Peebles, H.C.; Williamson, R.L. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 16p. (CONF-8705130—1). NTIS, PC A02. File Number DE87008507.

From International conference on laser advanced materials processing: science and applications; Osaka, Japan (21 May 1987).

Two possible mechanisms for laser power absorption in the metal vapor plume formed during Nd:YAG laser welding on commercially pure aluminum are examined. Results of emission spectroscopy of the plume indicate that the maximum electron density in the plume is too low to result in significant free-free absorption of the incident laser radiation. Particle condensation in the plume is observed. However, light scattering experiments indicate that the particles do not appear in the optical path of the weld laser during the period of the laser pulse.

41325 **(SAND—87-0648C) Time-resolved measurements of shock-induced vapor-pressure profiles.** Asay, J.R.; Trucano, T.G.; Chhabildas, L.C. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 7p. (CONF-870753—43). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012972.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

This paper describes the use of time-resolved interferometric techniques for direct measurement of the stagnation pressure histories produced by rapidly expanding vapors. The technique has been used to study the shock-induced vaporization of polymethyl methacrylate (PMMA), cadmium and lead. The experimental technique and preliminary data obtained on these materials are discussed.

41326 **(SAND—87-0677C) Hugoniot and wave-profile measurements on shock-loaded stainless steel (21Cr-6Ni-9Mn).** Wise, J.L.; Mikkola, D.E. (Sandia National Labs., Albuquerque, NM (USA); Michigan Technological Univ., Houghton (USA). Dept. of Metallurgical Engineering). 1987. Contract AC04-76DP00789. 5p. (CONF-870753—28). NTIS, PC A02/MF A01; GPO Dep. File Number DE87012734.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

A series of planar impact experiments has probed the shock response of 21Cr-6Ni-9Mn stainless steel targets loaded to peak stresses of 10 to 20 GPa. The impactor configuration produces a dwell time in the target (nominal thickness = 4 mm) of ~1 μs at the peak stress, followed by unloading to lower stresses through a rarefaction originating at the impactor rear surface. For each experiment, the target plate is backed by a transparent window, and a velocity interferometer monitors the motion of the target/window interface. Resultant velocity histories exhibit a distinct two-wave (elastic-plastic) loading structure from which the Hugoniot Elastic Limit (HEL), Hugoniot, shock strain rate, and shock viscosity for this alloy are determined.

41327 **(SAND—87-0774C) Heterogeneous deformation model for the high pressure strength of aluminum.** Swegle, J.W. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 6p. (CONF-870753—38). NTIS, PC A02. File Number DE87011063.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

Recent data from a series of reshock and unloading experiments on 6061-T6 aluminum have provided values of both yield strength and deviatoric stress in the initial shocked state. The data indicate that the stress state lies inside the yield surface after passage of the first shock wave. This is also supported by the appearance of an elastic precursor with the second shock in the reshock experiments. Standard elastic-plastic theories are unable to predict this anomalous behavior and postulated mechanisms have involved high temperature transients in regions associated with shear banding. Heat conduction normally occurs on time scales which are long compared to shock risetimes, but shear bands are so thin that they can be expected to thermally equilibrate with surrounding material in times comparable to shock risetimes. However, shock risetimes have been found to be a strong function of shock stress, and this effect must be included along with heat conduction in order to correctly calculate shear band temperatures. A recently developed viscous model provides correct shock wave risetimes in finite-difference wavecode calculations and has thus allowed the first capability for modeling the phenomenon of thermal trapping in shear bands. At low stresses, risetimes are long compared to thermal diffusion times and shear bands stay in thermal equilibrium with surrounding material, but at high stresses risetimes are very short, and shear band temperatures greatly exceed bulk temperatures before thermal equilibrium occurs. Decreasing yield strength with increasing shear band temperature followed by yield strength recovery due to thermal quenching as the shear bands cool produces good agreement with the experimental data on aluminum.

41328 **(SAND—87-0817C) Solid-state formation of icosahedral phases.** Follstaedt, D.M.; Knapp, J.A. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 15p. (CONF-8708104—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012718.

From Conference on solid state amorphizing transformation; Los Alamos, NM, USA (10 Aug 1987).

Formation of icosahedral Al-Mn and Al-Mn-Si in the solid state from deposited elemental layers by thermal transformation and by ion beam mixing is discussed. The formation by thermal interdiffusion and subsequent transformation to crystalline phases are examined in detail. The presence or absence of excess Al in the icosahedral alloys indicates the minimum Mn concentration of icosahedral Al-Mn in equilibrium with fcc Al: 15 +- 1 at.% Mn at 150°C.

41329 **(SAND—87-0830C) Effects of shock modification on the self-propagating high temperature synthesis of nickel aluminides.** Hammetter, W.F.; Graham, R.A.; Morosin, B.; Horie, Y. (Sandia National Labs., Albuquerque, NM (USA); North Carolina State Univ., Raleigh (USA)). Jul 1987. Contract AC04-76DP00789. 11p. (CONF-870753—39). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012729.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

Composite nickel-aluminum particles and compositionally similar mixtures of nickel and aluminum powders were subjected to controlled shock modification prior to initiation of a self-sustained high temperature synthesis reaction. For the mixed powders the shock event caused extensive mixing of the Ni and Al on a scale much finer than the original particle dispersion. In addition, an exothermic reaction associated with formation of an intermetallic composition was observed at a temperature below the normal initiation temperature of unshocked powders. For the shocked composite particles, no fine scale mixing was observed and no preinitiation exothermic events were noted. We concluded that shock-induced mixing of reactants leads to enhanced reactivity.

41330 **(SAND—87-0875C) Experimental and analytical study of an arc welding process.** Akau, R.L.; Krutz, G.W.; Schoenhals, R.J. (Sandia National Labs., Albuquerque, NM (USA); Purdue Univ., Lafayette, IN (USA)). 23 Jun 1987. Contract AC04-76DP00789. 14p. (CONF-8706110—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011094.

From 5. international conference on numerical methods for thermal problems; Montreal, Canada (29 Jun 1987).

This investigation involves both an experimental study of a GTAW (Gas Tungsten Arc Welding) process and the development of a numerical heat transfer model for the base material. Measured and calculated results will be compared to validate the thermal model. Actual welding (i.e., joining of metals) is not performed in this study. The welding process consists of just passing the arc over the base material. However, the results obtained can be readily applied to actual welding conditions.

41331 **(SAND—87-0886C) Shock-induced vaporization of porous aluminum.** Kerley, G.I.; Wise, J.L. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 5p. (CONF-870753—42). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012978.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

The expansion behavior of hot fluid aluminum was studied by shock-induced vaporization. Thin plates of porous aluminum (rho ≈ 1.6 Mg/m^3) were shocked to pressures of about 80 GPa, sufficient to produce vaporization upon release, then allowed to expand across a gap. The velocity time history produced by stagnation of the expansion products against a witness plate was measured using an interferometer. The experimental data were compared to one-dimensional wavecode calculations to evaluate the aluminum equation of state. A principal aim of this work was to test a theoretical prediction of a plasma phase transition in the hot expanded metal. However, the results do not provide any evidence for the existence of this transition.

41332 **(SAND—87-1871C) Modeling of chemical reactions in the mixture of Al-Ni powders under shock-wave compression.** Horie, Y.; Kipp, M.E. (North Carolina State Univ., Raleigh (USA); Sandia National Labs., Albuquerque, NM (USA)). Jul 1987. Contract AC04-76DP00789. 4p. (CONF-870753—41). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012979.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

Based upon microstructural observations of post-shock samples, a mathematical model was developed for chemical changes in the mixture of elemental Al and Ni powders from the passage of

high-pressure shock-wave. The model was solved and illustrated using the one-dimensional Sandia code WONDY-IV.

41333 **(SAND—87-8221) GTA weld penetration and the effects of deviations in machine variables.** Giedt, W.H. (Sandia National Labs., Livermore, CA (USA)). Jul 1987. Contract AC04-76DR00789. 46p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013410.

Analytical models for predicting the temperature distribution during GTA welding are reviewed with the purpose of developing a procedure for investigating the effects of deviations in machine parameters. The objective was to determine the accuracy required in machine settings to obtain reproducible results. This review revealed a wide range of published values (21 to 90%) for the arc heating efficiency. Low values (21 to 65%) were associated with evaluation of efficiency using constant property conduction models. Values from 75 to 90% were determined from calorimetric type measurements and are applicable for more accurate numerical solution procedures. Although numerical solutions can yield better overall weld zone predictions, calculations are lengthy and complex. In view of this and the indication that acceptable agreement with experimental measurements can be achieved with the moving-point-source solution, it was utilized to investigate the effects of deviations or errors in voltage, current, and travel speed on GTA weld penetration. Variations resulting from welding within current goals for voltage (+-0.1 V), current (+-3.0 A), and travel speed (+-2.0%) were found to be +-2 to 4%, with voltage and current being more influential than travel speed.

41334 **(UCID—20635-86-1) The titanium-aluminum-beryllium system's potential for metal matrix composites: Quarterly progress report.** Jacobson, L.A.; Tanner, L.E. (Lawrence Livermore National Lab., CA (USA)). Jan 1986. Contract W-7405-ENG-48. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013474.

The initial period of this investigation has led to some new findings regarding rapidly solidified microstructures, deviations from the published ternary phase diagram, and what appears to be excellent hardness retention after high-temperature exposure for several of the compositions in the aluminum-rich corner. More work is required before any conclusions can be drawn concerning the equilibrium and the non-equilibrium phase relationships, microstructure formation and transitions, and possible relationships to potentially useful mechanical properties.

41335 **(UCID—20703) Precision material removal project: Final report.** Donaldson, R.R. (Lawrence Livermore National Lab., CA (USA)). 22 Jul 1987. Contract W-7405-ENG-48. 53p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87013571.

This report describes high-precision single-point cutting studies done on molybdenum and beryllium using tungsten carbide and cubic boron nitride tools, plus associated characterization of the workpieces, cutting tools and machining chips, using interferometry, stylus profilometry, and optical and scanning electron microscopy.

41336 **(UCRL—96386) Microcrack dependent discontinuity conditions across a shock front.** Stout, R.B. (Lawrence Livermore National Lab., CA (USA)). Jun 1987. Contract W-7405-ENG-48. 11p. (CONF-870753—5). NTIS, PC A02/MF A01; GPO Dep. File Number DE87011888.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

A shock front analysis for propagating spatial discontinuities of microcrack density, mass density, momentum density, and energy density is developed. The analysis is based on concepts from discontinuum mechanics, which in the case of microcrack kinetics represents interatomic discontinuities between the surfaces of a microcrack by a relative deformation functional. The kinematics of the relative deformation functional decomposes the total relative velocity between atoms into two forms; one is a relative velocity function to describe the recoverable lattice structure motion, and the other is a relative velocity functional to describe the motion from discontinuities due to microcrack kinetics. This means that across a shock front involving microcrack kinetics, the discontinuity conditions for mass density, momentum density, and energy density will depend explicitly on the microcrack density function.

41337 **(UNI—3601-Add.1) Postirradiation examination of Pressure Tubes 2755 and 1054 Part 1: Dimensional, hydride, inner surface defects, and corrosion measurements: Addendum 1.** Chastain, S.A.; Trimble, D.J. (UNC Nuclear Industries, Inc., Richland, WA (USA)). Apr 1986. Contract AC06-76RL01857. 83p. NTIS MF A01; 2; GPO Dep. File Number DE87007105.

This addendum is issued to document additional postirradiation examinations that were conducted on Pressure Tubes 2755 and 1054 for evaluation of inner surface defects, corrosion and hydride measurements.

41338 **(VTT-TIED—643) Crack growth of intergranular stress corrosion cracks in austenitic stainless steel pipes of boiling water reactors.** Aho-Mantila, I.; Haenninen, H. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Dec 1986. 67p. (In Finnish). NTIS (US Sales Only), PC A04/MF A01. File Number DE87751943.

Intergranular stress corrosion cracking (IGSCC) of boiling water reactor (BWR) piping is considered from the crack growth rate point of view. Crack growth rate of sensitized austenitic stainless steel welds is dependent on the degree of sensitization of the material and the severity of the environment as well as the stress state. In evaluation of actual crack growth rate there are three major sources of uncertainty: knowledge of actual crack size and shape, actual stress distribution in the area of the crack and the degree of sensitization. In the report the crack growth calculations used in the USA and in Sweden are presented. Finally, the crack growth rate predictions based on mechanistic modelling of IGSCC and some needs of further research in Finland are considered.

41339 **(ZfK—609) Adsorption of volatile metals on metal surfaces and the possibilities of its application in nuclear chemistry. Calculation of enthalpies of dissoziative chemisorption of the rare earth and actinoide monoxides.** Eichler, B.; Huebener, S.; Rossbach, H. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). Dec 1986. 9p. (In German). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702882.

Partial molar enthalpies of dissociative chemisorption of the gaseous lanthanide and actinide monoxides have been calculated from the partial molar enthalpies of adsorption of the lanthanide and actinide metals and of atomic oxygen on metallic surfaces at zero coverage and from the enthalpy of the formation of gaseous monoxides from atoms. The influence of trace amounts of oxygen on the thermochromatographic process in metallic columns and on the thermal desorption from metallic surfaces is discussed.

41340 **Transmission gratings that diffract 8 keV x rays.** Bionta, R.M. (Lawrence Livermore National Laboratory, Livermore, California 94550). *Applied Physics Letters;* **51**: No. 10, 725-727(7 Sep 1987).

We have created and characterized a transmissive diffraction grating that disperses 8 keV x rays. The grating has a period of 7077 +- 70 A and consists of opaque zones of Ta separated by transparent zones of Al. It was fabricated by sputtering alternating layers of Al and Ta onto a glass optical flat and then slicing the coating into a 17-μm-thick slab. We tested the performance of the grating against a theoretical prediction by exposing the grating to 8 keV radiation from a Cu x-ray source and observing the interference pattern.

41341 **Work function of sputter-formed Re-1% Pd.** Gordon, R.L. (Pacific Northwest Laboratory, P.O. Box 999, Richland, Washington 99352). *Journal of Applied Physics;* **62**: No. 5, 1887-1894(1 Sep 1987). Contract AC06-76RL01830.

Appearance potential spectroscopy has been applied to the investigation of the relation between work function and surface composition for a sputter-formed alloy of Re-1% Pd. This approach permits point-by-point estimates of the work function to be

compared to corresponding measurements of surface composition. Developed techniques permit the use of nonlinear regression to analyze appearance potential and scanning Auger microprobe data from a single line scan on the Topping model of dipole layer formation. Resistively heated samples suffer segregation of Pd to the alloy surface and consequent increase in work function, with the amount of increase dependent upon the Pd-to-Re ratio at the surface. Preliminary results yielded different Topping parameters for low- and high-coverage regions. Values for dipole moment at zero electric field P_0 and polarizability α are $[P_0,\alpha] = [(6.1 +- 1.5) \times 10^{-30}$ C m, $(14.6 +- 6.6)$ A^3] or [$(1.7 +- 0.6) \times 10^{-30}$ C m, $(1.4 +- 0.4)$A^3], with Pd/Re less than or greater than 0.7, respectively. When the surface concentration of Pd is at least 0.2, a local increase in O concentration causes a local reduction of the work function on an otherwise clean alloy surface. On pure Re, or on a surface with substantial concentrations of other metallic impurities, oxygen adsorption causes an increase in work function. It is suggested that the appearance potential technique may be of value to the study of catalysis.

41342 **Constant flow electropolishing wand.** Fowler, G.L. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **5**: No. 5, 2981-2981(Sep 1987). Contract AC04-76DP00789.

This note describes an inexpensive, lightweight wand that simplifies local electropolishing inside, outside, and around newly welded appendages or sidearms of a vacuum vessel. The wand is easy to manipulate, and allows electropolishing solution to be continuously pumped into the working region at a constant rate without the necessity of submerging the entire workpiece in electropolishing solution. An insulating guard that acts as a reservoir for the electropolishing solution prevents shorting to the workpiece.

41343 **Quadrupolar coupling and structural instability in Ho/sub 1-//sub x/Y/sub x/Cu.** Abu-Aljarayesh, I.; Kouvel, J.S.; Brun, T.O. (Department of Physics, University of Illinois at Chicago, Chicago, Illinois 60680). *Physical Review [Section] B: Condensed Matter;* **36**: No. 4, 2000-2005(1 Aug 1987).

For pseudobinary Ho/sub 1-//sub x/Y/sub x/Cu compounds of $0 \leqq x \leqq 0.9$, magnetization-versus-field (M-versus-H) isotherms were measured in the paramagnetic temperature regime and compared with the corresponding isotherms of M versus total effective field (H/sub eff/) calculated from the crystal-field states of Ho/sup 3+/ in these cubic (CsCl-structured) compounds. From this comparison, which gives the net interaction field (H/sub int //sub = / H/sub eff/-H) as a function of M, it is deduced that as x rises from 0 to 0.9 the average bilinear exchange coefficient (which is negative) decreases in magnitude and almost vanishes, whereas the average quadrupolar coupling coefficient (which also is negative) increases in magnitude about eightfold. The anomalous strengthening of the effective quadrupolar coupling, which clearly does not derive from higher-order exchange, is ascribed to a growing instability of the cubic structure, which for $x \geqq 0.92$ transforms irreversibly upon cooling to another structure, as revealed by our resistivity measurements. This quadrupolar-coupling—structural-instability phenomenon appears to be analogous to that previously found in PrAg/sub 1-//sub x/Cu/sub x/.

41344 **Spectral evidence for the importance of single-site effects in heavy-fermion uranium materials.** Kang, J.; Allen, J.W.; Maple, M.B.; Torikachvili, M.S.; Pate, B.; Ellis, W.; Lindau, I. (Xerox PARC, 3333 Coyote Hill Road, Palo Alto, California 94304). *Physical Review Letters;* **59**: No. 4, 493-496(27 Jul 1987).

The 5f spectral weights in the heavy-fermion alloy system U/sub x/Y/sub 1-//sub x/Al_2 (x = 0.1,0.02) have been measured by resonant photoemission. The major features of the spectra of the dilute systems are identical to those for x = 1, showing that single-site effects dominate the large—energy-scale features of the spectrum even in the concentrated system.

41345 **Band-edge hydrostatic deformation potentials in III-V semiconductors.** Nolte, D.D.; Walukiewicz, W.; Haller, E.E. (Center for Advanced Materials, Lawrence Berkeley Laboratory and University of California, Berkeley, California 94720). *Physical Review Letters;* **59**: No. 4, 501-504(27 Jul 1987). Contract AC03-76SF00098.

We report experimental values for the band-edge hydrostatic deformation potentials of GaAs and InP semiconductors. The deformation potentials are determined directly by observation of the universal pressure derivative of transition-metal defect levels and consideration of this pressure derivative in the context of recent models of heterojunction band lineup. We obtain values of -9.3 and -7.0 eV for the conduction-band deformation potentials of GaAs and InP, respectively, determined from the uniaxial-stress deep-level transient spectroscopy on defect levels of Ti and V.

41346 **Interfacial anisotropy in magnetic superlattices.** Pechan, M.J.; Schuller, I.K. (Department of Physics, Miami University, Oxford, Ohio 45056). *Physical Review Letters;* **59**: No. 1, 132-135(6 Jul 1987).

We have observed large discrepancies between the dc magnetization and ferromagnetic resonance (FMR) magnetic anisotropy in Mo-Ni superlattices. We show that higher-order anisotropy is present in both measurements and develop an analysis by which the first-order and second-order energies can be treated independently. The low-temperature results show a systematic divergence of the first-order FMR and dc anisotropy as the Ni-layer thickness decreases. It is shown that the source of the divergence is an enhanced surface anisotropy measured by FMR. Possible sources of this enhancement are discussed.

41347 **Kinetic and nucleation limited stability of amorphous U_6Fe.** Nastasi, M.; Parkin, D.M. (Los Alamos National Lab., NM, USA). *Solid State Communications;* **62**: No. 9, 617-619(Jun 1987).

The amorphous phase stability in U_6Fe samples containing 2.7, 10.0, 20.0, 59.0, 87.0, 94.0, and 100% volume fraction amorphous phase has been examined. The crystallization temperature was observed to increase with an increasing volume fraction of amorphous phase. This observation is in direct conflict with the kinetic model of crystallization proposed for this alloy by Buschow and Beekmans. The observed transformation behavior can be explained using a crystal growth mechanism at low amorphous volume fractions and an interface energy/nucleation mechanism at larger volume fractions.

41348 **Isotope materials availability and services for target production at the Oak Ridge National Laboratory.** Ratledge, J.E.; Dahl, T.L.; Ottinger, C.L.; Aaron, W.S.; Adair, H.L. (Oak Ridge National Lab., TN). *Nuclear Instruments and Methods in Physics Research, Section B: Beam Interactions with Materials and Atoms;* **24/25**: No. 2, 937-943(Apr 1987). (CONF-861114—).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Materials available through the Isotope Distribution Program include separated stable isotopes, byproduct radioisotopes, and research quantities of source and special nuclear materials. Isotope products are routinely available in the forms listed in the product description section of the Isotopes Products and Services Catalog distributed by the Oak Ridge National Laboratory (ORNL). Different forms can be provided in some cases, usually at additional cost. Routinely available services include cyclotron target irradiations, fabrication of special physical forms, source encapsulation, ion implantation, and special purifications. Materials and services that are not offered as part of the routine distribution program may be made available from commercial sources in the United States. Specific forms of isotopic research materials include thin films and foils for use as accelerator targets, metal or other compounds in the form of bars or wires, and metal foils. Methods of fabrication include evaporation, sputtering, rolling, electrolytic deposition, pressing, sintering, and casting. High-purity metal forms of plutonium, americium, and curium are prepared by vacuum reduction/distillation. Both fissionable and nonfissionable neutron dosimeters are prepared for determining the neutron energy spectra, flux, and fluence

at various locations within a reactor. Details on what materials are available and how the materials and related services can be obtained from ORNL are described.

41349 **Identification of boron in $M_{23}X_6$ precipitates in 316 stainless steel using electron energy loss spectroscopy.** Mansfield, J.F. (Argonne National Lab., IL, USA). *Journal of Materials Science;* **22**: No. 4, 1277-1285(Apr 1987).

The paper concerns the location of boron in carbide precipitates in two casts of 316 steel with varying boron concentrations. Low-resolution location of the boron was performed by secondary ion mass spectrometry. The boron was mostly segregated to the grain boundaries of the steel. Scanning electron microscopy (SEM) and transmission electron microscopy (TEM) revealed that the grain boundaries were heavily coated with precipitates of the carbide $M_{23}X_6$ (M metal, X C, B, N). These precipitates were identified by X-ray energy-dispersive spectroscopy, in both the TEM and SEM, and convergent-beam electron diffraction in the TEM. Electron energy loss spectroscopy was employed to locate the boron within the carbides. The visibility of the boron K edge was enhanced by a digital filtering technique.

41350 **Metallic state.** Nevitt, M.V.; Brodsky, M.B. (Argonne National Lab., IL, USA). pp 1388-1416 of Chemistry of the actinide elements. Vol. 2. 2. Ed . Katz, J.J.; Morss, L.R.; Seaborg, G.T. (eds.). London, England; Chapman and Hall (1986).

Price Pound 110.00.

The physical properties of the actinide metals are reviewed and comparisons made with the properties of other metallic elements where possible. The chemical preparation of the pure actinide metals, their crystal-phase transformations and alloying relationships are all dealt with. Crystal structures, melting points, transformation temperatures and lattice constants are tabulated for the metals. In considering electronic structure, attention is drawn to the high density of electronic states at the Fermi level and values for properties related to this, such as electrical resistivity, specific heat and magnetic susceptibility, are listed. Since bulk mechanical properties such as strength, ductility and hardness require relatively massive samples, data for these is available only for Th, U and Pu. Related properties such as electronic specific heat and superconductivity are reviewed with the work on magnetism which currently tends to concentrate on local magnetic ordering.

41351 **Computer simulation of grain boundaries in Ni/sub 3/Al: The effect of grain boundary composition.** Chen, S.P.; Voter, A.F.; Srolovitz, D.J. (Los Alamos National Lab., Los Alamos, NM 87545). *Scripta Metallurgica;* **20**: No. 10, 1389-1394(1986).

The authors have performed atomistic simulations on three [001] symmetric tilt grain boundaries: Σ5(210), Σ(310), and Σ13(320). Depending on which sub-lattice in each of the two grains is occupied by Al, the grain boundary may have different stoichiometries. All of the simulations show that the Al-rich grain boundaries have the highest grain boundary energies. Thus Al-rich grain boundaries are more likely to fail than those which have the bulk stoichiometry or are Ni-rich. This conclusion is consistent with the observed stoichiometry dependence of the beneficial boron effect. The similarity between the grain boundary energies (cohesive energies) of Ni/sub 3/Al and Ni and the much higher yield stress of Ni/sub 3/Al provides a justification for the "inherent" brittleness of Ni/sub 3/Al grain boundaries.

41352 **On the limitations of dynamic recovery as revealed by temperature change tests at large strains.** Hughes, D.A.; Nix, W.D. (Sandia National Labs., Livermore, CA 94550). *Scripta Metallurgica;* **20**: No. 10, 1455-1458(1986). Contract AC04-76DP00789.

Because previous temperature change tests could not be continued to large strains, the effects of a low temperature prestrain on the large strain flow curve at a higher temperature have been found by extrapolation. These extrapolations have been based on the assumption that after prestraining at a lower temperature the stress-strain curve would rejoin the stress-strain curve obtained at a constant temperature. The temperature change tests described however, show this assumption to be false. The prestrained samples have a flow curve which is higher and parallel to that for the constant temperature test, indicating the important result that some elements in the dislocation substructure cannot be dynamically recovered. Additionally, a dislocation structure which does not recover when deformation is continued at a higher temperature (but still within the low temperature regime) demonstrates the limitations of dynamic recovery.

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REFER ALSO TO CITATION(S) 40346, 40879, 40879, 40963, 41066, 41432, 42849, 42855, 42856

41353 **(AD-A—180314/7/XAB) Preparation and properties of cubic ZrO_2 stabilized with Ni(ii). Technical report.** Smith, K.E.; Kershaw, R.; Dwight, K.; Wold, A. (Brown Univ., Providence, RI (USA). Dept. of Chemistry). 15 May 1987. 10p. (TR—5). NTIS, PC A02/MF A01.

The Fischer-Tropsch activity of the nickel-zirconia system has been investigated and preparations of the catalyst involving co-precipitation gave a significantly more active catalyst than did preparations involving impregnation. Stabilization towards reduction has been observed when certain transition-metal ions such as Rh(III) are inserted into the fluorite ZrO_2 structure. Recent investigations using the NiO/ZrO_2 system have concluded that NiO does not interact with zirconium oxide, but the materials were prepared by incipient wetness. It was the purpose of this study to investigate the formation of cubic ZrO_2 stabilized with Ni(II) and to relate the structural properties of the catalyst with its observed stability in reducing atmospheres. These properties were then compared to those of catalysts prepared by incipient wetness. Changes in the structure of ZrO_2 and in the temperatures at which reduction of Ni(II) to Ni metal occurred were then related to the relative strengths of the catalyst-support interaction.

41354 **(AD-A—180411/1/XAB) Stabilization of cubic ZrO_2 with Rh(iii) and/or La(iii). Technical report.** Zhang, Y.C.; Kershaw, R.; Dwight, K.; Wold, A. (Brown Univ., Providence, RI (USA). Dept. of Chemistry). 15 May 1987. 18p. (TR—6). NTIS, PC A02/MF A01.

Samples of stabilized cubic zirconium oxide were prepared containing rhodium(III), lanthanum(III), and both La(III) and Rh(III). The properties of these compounds were studied by x-ray analysis and temperature-programmed reduction. These studies indicated that the cubic phase becomes stabilized with the incorporation of La(III) or Rh(III) into the ZrO_2 structure.

41355 **(AD-A—180414/5/XAB) Preparation and characterization of cubic ZrO_2 stabilized by Fe(iii) and Fe(ii). Technical report.** Davison, S.; Kershaw, R.; Dwight, K.; Wold, A. (Brown Univ., Providence, RI (USA). Dept. of Chemistry). 15 May 1987. 17p. (TR—7). NTIS, PC A02/MF A01.

Samples of cubic zirconium oxide contained 2.5at% - 40at% ferric iron were prepared by codecomposition of the nitrates. X-ray powder-diffraction analysis and magnetic measurements indicated that alpha iron nitrate and ZrO_2 form a solid solution up to 25at% Fe/Zr in the product. At this point, the solubility limit of alpha-Fe_2O_3 in ZrO_2 is exceeded. The reduction of cubic zirconia samples containing 2.5 - 20at% Fe(III) leads to the stabilization of iron (II) in the zirconia lattice. Reduction to metallic iron occurs at much higher temperatures than the reduction of bulk alpha-Fe_2O_3.

41356 **(AD-A—180487/1/XAB) Thermomechanical contact phenomena and wear of sliding components. Annual report, 1 January-31 December 1986.** Kennedy, F.E.; Hussaini, S.Z.; Espinoza, B.M. (Dartmouth Coll., Hanover, NH (USA). Thayer School of Engineering). 27 Mar 1987. 53p. NTIS, PC A04/MF A01.

Objectives of this work were to gain a better understanding of the wear of solid ceramic and ceramic-coated metallic seal rings in contact with carbon graphite and to determine the solid/solid contact conditions responsible for that wear. Ring-on-ring tests were run under dry conditions (no sealed fluid) with carbon graphite seal rings sliding against two types of hard-seal-face materials, monolithic silicon carbide and metallic materials coated with either

tungsten carbide or titanium nitride. The total wear of the hard ring materials were very low in all cases, with reaction-sintered silicon carbide and titanium nitride-coated rings having the lowest total wear. There was less wear of the carbon graphite rings when they were run against coated rings than in contact with SiC. In the analytical phase of this work, the temperature and stress distributions in the sliding contact region were determined using finite element methods. It was shown that frictional heating is the dominant contributor to high localized stresses in the contact region, that plastic deformation can occur in the region, and that thermal deformations and stresses can be a major reason for coating failure. The influence of coating and substrate properties, as well as coating thickness, on the results and on potential failure mechanisms were studied.

41357 **(BNL—40040) An analytical electron microscopy study of high T/sub c/ superconductors.** Sabatini, R.L.; Heald, S.M.; Suenaga, M.; Moodenbaugh, A.R.; Jones, R.H. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 6p. (CONF-870725—9). NTIS, PC A02. File Number DE87012869.

From 22. annual meeting of the Microbeam Analysis Society; Kailua-Kona, HI, USA (13 Jul 1987).

The high T/sub c/ material $YBa_2Cu_3O_7$ shows a complex relationship between microstructure and oxygen content. The microstructure reveals high angle grain boundaries and extensive twinning along (110) planes in the orthorhombic phase. The EELS results on the oxygen K-edge are strongly dependent upon oxygen content. Work is continuing to relate these results with the superconducting properties, and a determination of the nature of the oxygen vacancy sites.

41358 **(DOE/ID/12626—T1) Ordered ceramic membranes: Annual progress report, February 1986-March 1987.** Anderson, M.A.; Hill, C.G. Jr. (Wisconsin Univ., Madison (USA)). Jun 1987. Contract AS07-86ID12626. 63p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87012714.

Effort has focused on the solution variables that ultimately control the characteristics of the precursor sols, gels, and the ceramic membranes. We have succeeded in producing "crack-free" Al_2O_3 and TiO_2 unsupported ceramic membranes. The Al_2O_3 membranes are "particulate" whereas we have been preparing both polymeric and particulate TiO_2 unsupported membranes. These membranes have pore diameters in the 20 to 50 A range. Major variables in both cases include the alkoxide/water ratio and the initial time and temperature of the reaction. Ionic strength seems to be of lesser importance. Sintering conditions are also important in controlling the pore size. The TiO_2 membranes supported by glass substrates are photoactive and capable of degrading polychlorinated biphenyls in aqueous solution when exposed to uv irradiation. We have also been experimenting with two types of supporting materials for producing ceramic filters. Both clay and alumina precursors have yielded supports that had sufficient strength and porosity to be candidates for membrane supports.

41359 **(INIS-BR—668) Toughening of α aluminia - preliminary results.** Souza, D.M.P.F.; Casarini, J.R.; Moreira, N.; Pegolo, M. (Sao Carlos Univ. (Brazil). Dept. de Engenharia de Materiais). 1987. 10p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702776.

The results of ceramic processing of aluminium hydroxide and zirconia partially stabilized with yttria are presented.

41360 **(IS-T—1234) Preparation of monodispersed yttrium hydroxycarbonate spheres by homogeneous precipitation.** Verlinden, M.C. (Ames Lab., IA (USA)). Jun 1987. Contract W-7405-ENG-82. 62p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87013071.

Highly monodisperse, submicrometer size, spherical particles of yttrium hydroxycarbonate were prepared by homogeneous precipitation from a yttrium nitrate-urea solution. The precipitant, CO_2, was generated by thermal decomposition of the urea when the solution was heated to 90 to 100°C. The amorphous precipitate particles, which had the chemical formula, $Y(CO_3)OH.H_2O$, suffered a 30% weight loss when calcined to polycrystalline Y_2O_3, but maintained their sphericity. Spherical particles were obtained only over a limited range of reactant ratios. Particle sizes ranged from 0.1 μm to 0.7 μm and, of the seventeen different run conditions for which discrete spherical particles were obtained, only one run produced spheres whose diameters had a geometric standard deviation greater than 1.10. The growth of the particles, followed by in situ laser light scattering during the precipitation reaction, was best described by a model based on the decomposition of urea as the rate-limiting step in the process.

41361 **(KU-HCOE-FL2-R—85-16) High-pressure structural studies of UC by X-ray diffraction and synchrotron radiation.** Staun Olsen, J.; Gerward, L.; Benedict, U.; Itie, J.P.; Richter, K. (Copenhagen Univ. (Denmark). H.C. Oersted Inst.). 1985. 16p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87752326.

High-pressure X-ray diffraction studies have been performed on UC powder for pressures up to 46 GPa using a diamond anvil cell and synchrotron radiation. The low-pressure phase is of NaCl-type with the lattice constant a/sub 0/=4.9606(5) A at ambient pressure. The bulk modulus and its pressure gradient are B/sub 0/=155(10) GPa and B/sub 0/′=7.9(14), respectively. A transformation to a new phase, UC II, has been found at about 27 GPa. The diffraction lines from the high-pressure phase can be indexed using a pseudo-bodycentred orthorhombic unit cell, which is a distortion of the body-centred tetragonal unit cell of the fcc lattice. The lattice constants at 33.6 GPa are a=3.043(10) A, b=3.518(16) A and c=4.730(7) A. The experimental equation of state has been compared with results of theoretical calculations.

41362 **(KU-HCOE-FL2-R—85-18) Investigations of the phase transition in V/sub 3/O/sub 5/ using energy dispersive X-ray diffraction and synchrotron radiation white beam X-ray topography.** Asbrink, S.; Gerward, L.; Staun Olsen, J. (Copenhagen Univ. (Denmark). H.C. Oersted Inst.). 1985. 22p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87752328.

The reversible first order phase transition in V/sub 3/O/sub 5/ at T/sub t/=155/sup 0/C has been studied using a specially constructed oven, where the temperature can be kept constant within a few hundredths of a degree for several hours. Energy dispersive diffraction measurements have beem made in a temperature region around the phase transition with the fixed crystal method and the $\theta/2\theta$ scanning method. White beam X-ray topographs have been obtained from the same crystal in the same temperature region using synchrotron radiation. The integrated intensities of the strong h 0 0 reflections show anomalies that are correlated with the corresponding X-ray topographs. Thus, an unexpected increase of crystal perfection is observed a few hundredths of a degree below T/sub t/. The energy dependence of the intensity maximum at T/sub t/ for strong reflections has been determined and semi-quantitatively explained on the basis of extinction theory.

41363 **(KU-HCOE-FL2-R—86-1) Structural stability and equation of state of thorium carbide for pressures up to 36 GPa.** Gerward, L.; Staun Olsen, J.; Benedict, U.; Itie, J.P.; Spirlet, J.C. (Copenhagen Univ. (Denmark). H.C. Oersted Inst.). 1986. 15p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87752331.

High-pressure X-ray diffraction studies have been performed on ThC powder up to 36 GPa. No structural phase transformation has been observed, the rocksalt structure of ThC being stable in the whole pressure range. The equation of state can be described by the Murnaghan equation with the bulk modulus B/sub 0/=109(7) GPa and its pressure derivative B/sub 0/′=3.1(6). The high-pressure behaviour of ThC is compared with that of other actinide carbides and nitrides and correlated with the occupation of the 5f electron shell.

41364 **(PNL-SA—14930) Improved ceramic composites through fiber-matrix interaction.** Bates, J.L.; Griffin, C.W.; Weber, W.J.; Courtright, E.L. (Pacific Northwest Lab., Richland, WA (USA)). May 1987. Contract AC06-76RL01830. 16p. (CONF-8705103—10). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013326.

From Fossil energy materials program conference; Oak Ridge, TN, USA (19 May 1987).

Preliminary analyses of matrix/fiber interactions between Si_3N_4 matrix with 5 wt. % MgO added as a sintering aid, and Nicalon silicon carbide fibers have been performed. Specimens with 0, 10, and 30 vol.% fibers were prepared by hot pressing at 1750°C in one atmosphere of nitrogen. Specimen characterization revealed that a significant amount of magnesium diffuses into the silicon carbide fibers during fabrication. Free carbon on the surface of the Nicalon appears to play an important role in debonding. No evidence of Si enrichment or SiO_2 formation have been found at the interfaces. 6 refs., 7 figs., 2 tabs.

41365 **(SAND—86-2666C) Thermal conductivity of boron carbides.** Moss, M. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 7p. (CONF-870438—31). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012016.

From Spring meeting of the Materials Research Society; Anaheim, CA, USA (21 Apr 1987).

The thermal conductivity, k, of boron carbides of various B/C ratios, two modes of preparation - hot pressed and carbothermic, and two isotopic variants of boron - ^{11}B and normal boron /sup 10.81/B, was measured from 300 to 1023 K. The density and composition of the samples were reflected in the magnitude and temperature dependence of k, and were investigated further with scanning electron microscopy, Rutherford backscattering spectroscopy, and Raman spectroscopy. While lower than theoretical density in B_4C reduces k, the characteristic monotonic decline of k with increasing temperature is retained. This -k-vs.-T behavior distinguishes B_4C from material with larger B/C ratios for which the temperature dependence is essentially nil.

41366 **(SAND—87-1653C) Grain decoupling at low magnetic fields in ceramic YBa_2Cu_3O/sub 7-delta/.** Kwak, J.F.; Venturini, E.L.; Ginley, D.S.; Fu, W. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 9p. (CONF-870682—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012358.

From Workshop on novel mechanisms for superconductivity; Berkeley, CA, USA (22 Jun 1987).

We observe evidence for grain decoupling at low magnetic fields in ceramic YBa_2Cu_3O/sub 7-delta/. We find the bulk critical current density of ceramic 123 compound to be unambiguously due to Josephson coupling between grains, based on a theoretical fit to the measured field dependence of J/sub c/. At very low fields the junctions can no longer maintain screening currents and the grains' magnetic response is decoupled. This decoupling is seen in the magnetization versus increasing field. At very low fields the diamagnetic screening appears to be perfect, but drops considerably upon decoupling. The Meissner effect always reflects decoupled grains and the uniaxial anisotropy of the superconductivity. We know that the zero-field critical current density interior to the grains is actually quite high ($>10^6$ A/cm^2 at 5 K) from an analysis of the observed remanent magnetization in terms of decoupled grains. Finally, we note that the bulk J/sub c/ provides a sensitive measure of H/sub c1/.

41367 **Nature of defect structure in CoO.** Khowash, P.K.; Ellis, D.E. (Department of Physics and Astronomy, Northwestern University, Evanston, Illinois 60201). *Physical Review [Section] B: Condensed Matter;* **36**: No. 6, 3394-3399(15 Aug 1987).

The defect structure in CoO is examined in an embedded-molecular-cluster model. The point-defect model with isolated vacancies on either metal or oxygen sites is evaluated and compared with more complex defect structures. We calculate the electronic structure of 4:1 interstitial defects and some of their aggregates in CoO. The binding energy is determined to reveal the most stable defect structure, which is the 4:1 tetrahedral complex in this case. Mulliken population analysis and volume integration confirm the formation of a Co/sup 3+/ cation at the tetrahedral site.

41368 **Alpha-decay-induced fracturing in zircon: the transition from the crystalline to the metamict state.** Chakoumakos, B.C.; Murakami, T.; Lumpkin, G.R.; Ewing, R.C. (Univ. of New Mexico, Albuquerque). *Science (Washington, D.C.);* **236**: 1556-1559(19 Jun 1987). Contract FG04-84ER45099.

A natural single crystal of zircon, $ZrSiO_4$, from Sri Lanka exhibited zonation due to alpha-decay damage. The zones vary in thickness on a scale from one to hundreds of micrometers. The uranium and thorium concentrations vary from zone to zone such that the alpha-decay dose is between 0.2×10^{16} and 0.8×10^{16} alpha-event per milligram (0.15 to 0.60 displacement per atom). The transition from the crystalline to the aperiodic metamict state occurs over this dose range. Differential expansion of individual layers due to variations in their alpha-decay dose caused a systematic pattern of fractures that do not propagate across aperiodic layers. High-resolution transmission electron microscopy revealed a systematic change in the microstructure from a periodic atomic array to an aperiodic array with increasing alpha-decay dose. At doses greater than 0.8×10^{16} alpha-events per milligram there is no evidence for long-range order. This type of damage will accumulate in actinide-bearing, ceramic nuclear waste forms. The systematic pattern of fractures would occur in crystalline phases that are zoned with respect to actinide radionuclides.

41369 **Superconductivity at 91 K in the magnetic oxide $HoBa_2Cu_3O$/sub 6+x/.** Porter, L.C.; Thorn, R.J.; Geiser, U.; Umezawa, A.; Wang, H.H.; Kwok, W.K.; Kao, H.I.; Monaghan, M.R.; Crabtree, G.W.; Carlson, K.D.; Williams, J.M. (Argonne National Lab., IL). *Inorganic Chemistry;* **26**: No. 11, 1645-1646(3 Jun 1987). Contract W-31-109-ENG-38.

A remarkable increase in T/sub c/ (superconducting transition temperature) to temperatures near 90 K has been reported recently for a phase of the Y-Ba-Cu-O system, variously identified as YBa_2Cu_3O/sub 9-δ/ ($\delta = 2.1$), YBa_2C_3O/sub 6+x/ ($x = 0.5$), and YBa_2Cu_3O/sub 6.81/. Relatively sharp superconducting transitions occur for this material with onset T/sub c/'s at 93-98 K, with zero resistance at 80-94 K, and with substantial Meissner effects measured at temperatures not far below zero resistance. This superconducting oxide is a compound similar in metal stoichiometry to $Y_2Cu_2O_5$ on the basis of the total noncopper metal-to-copper atomic ratios. It is well documented that, in addition to Y, the lanthanide ions, Ln^{3+}, with more than seven 4f electrons form similar compounds, $Ln_2Cu_2O_5$. Consequently, one speculates that superconducting oxides with T/sub c/'s near 90 K might also occur for compositions $LnBa_2Cu_3O$/sub 6+x/, where Ln^{3+} is any one of the heavier lanthanide ions. An interesting question in this case is the effect of the magnetic moment on superconductivity. The presence of the moment decreases T/sub c/ through exchange interactions and, if magnetic ordering occurs, may lead to the coexistence of superconductivity and magnetism, or reentrant superconductivity (reentrant means return to the normal state). They have chosen to explore the synthesis and superconducting properties of $HoBa_2Cu_3O$/sub 6+x/ because Ho^{3+} has the same radius as nonmagnetic Y^{3+} (0.89 A)[8] and, along with Dy^{3+}, has the largest magnetic moment (10.4 μ/sub B/) of the Ln^{3+} ions. In the course of this work, conflicting reports have appeared which indicate that an uncharacterized phase (or phases) of the Ho-Ba-Cu-O system is superconducting with T/sub c/'s of ~ 46, 70, or 93 K. In this communication they report on bulk superconductivity near 91 K without reentrant behavior down to 0.55 K for $HoBa_2Cu_3O$/sub 6+x/.

41370 **Mechanical properties and oxidation behavior of a hot-pressed SiC-15-vol%-TiB/sub 2/ composite.** Janney, M.A. (Oak Ridge National Lab., Metals and Ceramics Div., Oak Ridge, TN 37831). *American Ceramic Society Bulletin;* **66**: No. 2, 322-324(Feb 1987). Contract AC05-84OR21400.

The strength, fracture toughness, and oxidation behavior of a hot-pressed SiC-TiB/sub 2/ composite (with B and C additions) were investigated. Adding 15 vol% TiB/sub 2/ to an SiC matrix increased the mean strength and mean fracture toughness of the composite by 28% and 45%, respectively. Oxidation of the SiC-15-vol%-TiB/sub 2/ composite occurred slowly at 1000°C and 1200°C but was catastrophic at 1400°C.

41371 **Sintered Al/sub 2/O/sub 3/-SiC-whisker composites.** Tiegs, T.N.; Becher, P.F. (Oak Ridge National Lab., Metals and Ceramics Div., Oak Ridge, TN 37831). *American Ceramic Society Bulletin;* **66**: No. 2, 339-342(Feb 1987). Contract AC05-84OR21400.

Pressureless sintering of Al/sub 2/O/sub 3/-SiC-whisker composites is a viable method of fabrication. Densification of pressed powder-whisker compacts is inhibited by the SiC whiskers because rearrangement of the whiskers during shrinkage is difficult. To promote sintering, a number of techniques were effective, such as lowering the whisker aspect ratio, adjusting the Al/sub 2/O/sub 3/ particle size to optimize green density and use of a liquid phase sintering aid (e.g., Y/sub 2/O/sub 3/ and MgO). At the present time, Al/sub 2/O/sub 3/-SiC-whisker composites with loadings ≦10 vol% whiskers can be successfully sintered to ≧ 95% of theoretical density and hot isostatically pressed without encapsulation to >98% of theoretical density. With whisker contents >10 vol%, densification is severely inhibited and sintered materials without closed porosity are obtained.

41372 **Crystal chemistry of ABO/sub 4/ compounds.** Aldred, A.T. (Argonne National Lab., Materials Science and Technology Div., Argonne, IL 60439). pp 305-314 of Geochemical behavior of disposed radioactive waste. Barney, G.S.; Navratil, J.D.; Schulz, W.W. Washington, DC; American Chemical Society (1984). (CONF-830303—).

From 185. American Chemical Society national meeting; Seattle, WA, USA (20 Mar 1983).

To evaluate the factors affecting the structural stability of some crystalline materials that are potential hosts for radioactive wastes, the crystal structures of a series of A/sup 3+/P/sub 1-x//sup 5+/V/sub x//sup 5+/O/sub 4/ compounds, where A is lanthanum or a member of the rare-earth series, were determined. The end-member phosphates (APO/sub 4/) have the monoclinic Monazite structure (P2/sub 1//n) for A - La, Ce-Gd, and the tetragonal Zircon structure (I4/sub 1//amd) for A = Tb - Lu. The corresponding vanadates have the Monazite structure only for LaVO/sub 4/, and the Zircon structure for A = Ce - Lu. The pervasive polymorphism of these ABO/sub 4/ compounds, involving both reconstructive and displacive transformations and metastable structures produced by different sample preparation methods, indicates that the crystal structural stability of substituted compounds needs to be carefully evaluated as a function of temperature to assess the structural integrity of waste-form materials.

41373 **Transformation characteristics of LaV/sub x/Nb/sub 1-x/O/sub 4/ compounds.** Nevitt, M.V.; Aldred, A.T. (Argonne National Lab., Materials Science and Technology Div., Argonne, IL 60439). pp 315-322 of Geochemical behavior of disposed radioactive waste. Barney, G.S.; Navratil, J.D.; Schulz, W.W. Washington, DC; American Chemical Society (1984). (CONF-830303—).

From 185. American Chemical Society national meeting; Seattle, WA, USA (20 Mar 1983).

X-ray diffractometry measurements were made as a function of temperature on a series of polycrystalline LaV/sub x/Nb/sub 1-x/O/sub 4/ compounds ($0 < x \leqq 0.3$) to determine the effect of V substitutions on the temperature of the monoclinic/tetragonal transformation. The purpose of this paper is to provide basic information relating to crystal lattice stability in ABO/sub 4/ compounds that are either candidates or are appropriate models for candidate materials for hosting nuclear waste ions. Partial substitution of V/sup 5+/ on the Nb/sup 5+/ site significantly lowers the tetragonal scheelite (I4/sub 1//a) to monoclinic fergusonite (I2/c) transformation, from 770 K in LaNbO/sub 4/ to approximately 215 K to LaV/sub 0.25/Nb/sub 0.75/O/sub 4/ (the solubility limit is close to x = 0.35). The transformation is displacive, of second order, involving two coupled order parameters. Heat capacity measurements on LaV/sub 0.25/Nb/sub 0.75/O/sub 4/ showed that the specific heat anomaly at the transformation point is extremely small. It is concluded that the two polymorphic forms of LaV/sub x/Nb/sub 1-x/O/sub 4/ have very nearly the same free energies over a substantial range of temperature below the transformation.

3606 Other Materials

REFER ALSO TO CITATION(S) 40514, 40551, 40574, 40575, 40576, 40578, 40579, 40580, 40581, 40582, 40584, 40585, 40586, 40587, 40588, 40589, 40590, 40594, 40595, 40596, 40596, 40597, 40598, 40615, 40616, 40619, 40620, 40633, 40634, 40635, 40643, 40648, 40649, 40650, 40981, 41137, 41137, 41137, 41206, 41325, 41660, 41739, 41921, 41922, 41923, 41924, 42642, 42643, 42668, 42670, 42839, 42839, 42840

41374 **(AD-A—180234/7/XAB) DLTS analysis and modeling of electron- and proton-irradiated (AlGa)As/GaAs multijunction solar cells. Final report, October 1985-October 1986.** Li, S.S. (Florida Univ., Gainesville (USA). Dept. of Electrical Engineering). Mar 1987. 44p. NTIS, PC A03/MF A01.

A numerical model was developed to calculate the displacement defects, the damage constant of minority-carrier diffusion length, and the degradation of short-circuit current (I/sub sc/), open circuit voltage (V/sub oc/) and conversion efficiency (eta/sub c/) in the 1-MeV electron- and proton-irradiated AlGaAs/GaAs/InGaAs multijunction solar cell under normal incidence conditions. The results show good agreement between calculated values and the experimental data of I/sub sc/, V/sub oc/ and eta/sub c/. In addition, DLTS analysis of defects in AlGaAs p-n junction solar cells irradiated by 1-MeV electrons has also been carried out in this work. The I-V analysis on several MOCVD-grown Ge/GaAs tunnel junction diodes has also been made in this study.

41375 **(AD-A—180242/0/XAB) Radiation effects and anelastic loss in germanium-doped quartz.** Euler, F.K.; Kahan, A. (Air Force Rome Air Development Center, Hanscom AFB, MA (USA). Deputy for Electronic Technology). 15 Mar 1987. 10p. (RADC/ETR—87-0004). NTIS, PC A02/MF A01.

Pub. in Physical Review B, Vol. 35, No. 9, 4351-4359(15 Mar 1987).

5-MHz resonators were fabricated from germanium-doped cultured quartz and were cobalt-60 irradiated at room temperature. The quartz has a relatively low aluminum-impurity concentration, 0.5 ppm, and the aluminum is lithium compensated. Oscillator frequency offsets delta f/f and resonator anelastic loss spectrum 1/Q were measured and show an increase and subsequent decrease as a function of dose, known as radiation bleaching. At low irradiation levels, delta f/f decreases with increasing dose, reaches at 50 krad a minimum of $-4X10^{7}$. (1 rad=100 ergs/g.) These values are surprisingly large in comparison with other lithium-compensated high-quality quartz. Resonator irradiation induces a 1/Q peak centered at 246 K, which also bleaches with radiation. At 246 K the Q value is 2,250,000, decreases with irradiation, reaches at 50 krad a minimum of 650,000, and recovers at 350 krad to 1,500,000. Electron paramagnetic resonance (EPR) measurements show aluminum holes, germanium C and A centers, Ge(C)-Li and Ge(A)-Li, and neutral defects of a trapped electron localized on a substitutional Ge site and stabilized by an adjacent Li^{+} ion. All three EPR spectra also radiation bleach at doses above 50 krad. This strongly suggests that the Ge(C)-Li defect is associated with the 246-K loss peak. The activation energy of the 1/Q peak is E=0.22 eV, the corresponding relaxation time tau_0 $8X10^{13}$ sec, and the peak anneals at 555 K.

41376 **(AD-A—180456/6/XAB) Damping characteristics of metal-matrix composites. Quarterly progress report No. 5, 10 December 1986-8 April 1987.** (Martin Marietta Aerospace, Denver, CO (USA)). 8 Apr 1987. 6p. (MCR—85-721). NTIS, PC A02/MF A01.

Work Accomplished in Damping Behavior of Germanium/Alumina Composites is reported: i) Developed damping test techniques to obtain reliable measurements with metal-matrix composites in flexural and extensional modes of vibration between 1×10^{-6} and 800×10^{-6} strain-amplitude levels within 0.1- to 150-Hz frequency range. ii) At strain levels $< 10^{-6}$, specific damping capacity (pi) of P55Gr/6061Al was amplitude-independent and lower than values of the aluminum matrix. iii) Damping behavior at these strain levels (10 -5), is consistent with the values predicted by Hashin theory using damping properties of constituent fiber and matrix materials. iv) At strains > 10 -5, psi of P55Gr/6061A1 exhibited strain-amplitude-dependent behavior. In this strain-ampli-

tude region, the average psi value was higher than the psi values for the aluminum matrix, particularly in the extensional mode of vibration.

41377 **(AD-A—180473/1/XAB) Device physics of superlattices and small structures. Final report, 1 August 1983-30 November 1986.** McGill, T.C. (California Inst. of Tech., Pasadena (USA)). 10 Apr 1987. 88p. NTIS, PC A05/MF A01.

Experimental and theoretical studies are presented of HgTe-CdTe superlattices. The first study of the photoluminescence and photoconductivity spectra of superlattices is reported. Photoluminescence, photoconductivity, and infrared absorption all point to the same band gap for the superlattice. Theoretical studies of these superlattices have given the first estimates of the magnitude of the optical absorption, the first study of the role of strain, and the first study of the role of the band offset in determining the properties of superlattices. The authors have also invented a novel electronic device that has negative resistance based on HgCdTe-CdTe-HgCdTe heterostructures. The first theoretical studies of superlattices were carried out that include dilute magnetic semiconductors. Superlattices of CdTe-ZnTe were studied experimentally and theoretically to give the first investigations of the properties of possible II-IV visible-light emitters.

41378 **(CONF-870438—32) Ion implantation and annealing of $SrTiO_3$ and $CaTiO_3$.** White, C.W.; Boatner, L.A.; Rankin, J.; Aziz, M.J. (Oak Ridge National Lab., TN (USA); Massachusetts Inst. of Tech., Cambridge (USA); Harvard Univ., Cambridge, MA (USA). Div. of Applied Sciences). 1987. Contract AC05-84OR21400. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011640.

From Spring meeting of the Materials Research Society; Anaheim, CA, USA (21 Apr 1987).

Ion implantation damage and thermal annealing results are presented for single crystals of $SrTiO_3$ and $CaTiO_3$. The near-surface region of both of these materials can be made amorphous by low doses ($\sim 10^{15}/cm^2$) of heavy ions (Pb at 540 keV). During annealing, the amorphous implanted region crystallizes epitaxially on the underlying single-crystal substrate. The kinetics of this solid-phase epitaxial recrystallization process have been measured by employing ion channeling techniques.

41379 **(CONF-870462—1-Draft) Z-contrast imaging of dopant precipitation and redistribution during solid and liquid phase epitaxial growth of ion-implanted Si.** Pennycook, S.J.; Berger, S.D.; Culbertson, R.J. (Oak Ridge National Lab., TN (USA)). Jul 1987. Contract AC05-84OR21400. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012534.

From 5. Institute of Physics conference on microscopy of semiconducting materials; Oxford, UK (6 Apr 1987).

Z-contrast STEM using a high angle annular detector has been used to study precipitation and redistribution of dopant during solid and liquid phase epitaxial growth of In^+ and Sb^+ implanted Si. Both the pile-up phenomenon seen during solid phase regrowth and the long-range redistribution of dopant accompanying amorphous to polycrystalline transformation have been directly linked to the presence of highly mobile liquid precipitates. Quantitative Z-contrast imaging has been used to study the dopant distribution between cell walls following pulsed laser annealing. The potential of Z-contrast STEM for providing high resolution atomic structure imaging with high elemental sensitivity is discussed.

41380 **(CONF-870783—1) Ion implantation and annealing of crystalline oxides and ceramic materials.** White, C.W.; Boatner, L.A.; Sklad, P.S.; McHargue, C.J.; Rankin, J.; Farlow, G.C. Aziz, M.J. (Oak Ridge National Lab., TN (USA)). May 1987. Contract AC05-84OR21400. 37p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87012290.

From Radiation effects in insulators-4 conference; Lyon, France (6 Jul 1987).

The response of several crystalline oxides or ceramic materials to ion implantation and subsequent thermal annealing is described. For both $SrTiO_3$ and $CaTiO_3$ single crystals, the near-surface region can be turned amorphous by relatively low doses of heavy ions (Pb, $10^{15}/cm^2$, 540 keV). During annealing, the amorphous region recrystallizes epitaxially with the underlying substrate by simple solid-phase epitaxy, and the crystallization kinetics have been determined for both of these materials. In Al_2O_3, the amorphous phase of the pure material is produced by a stoichiometric implant at liquid nitrogen temperature. During annealing, the amorphous film crystallizes in the (crystalline) γ phase, followed by the transformation of the γ to the α phase at a well-defined interface. The kinetics characterizing the growth of α-Al_2O_3 have been determined. Preliminary results are presented on the effect of impurities (Fe) on the nature and kinetics of the crystallization of amorphous Al_2O_3.

41381 **(DOE/ER/45105—T1) Polymer chain segment orientation during stress relaxation.** Prud'homme, R.K.; Koberstein, J.T. (Princeton Univ., NJ (USA). Dept. of Chemical Engineering). Jul 1987. Contract FG02-84ER45105. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013392.

This report presents results on simultaneous measurement of stress and molecular orientation on uniaxially stretched polymer films. Stress is measured using a force transducer and orientation using infrared dichroism. A set of deuterated polystyrene samples were prepared with deuterated blocks at either the center or ends of the polymer chains. Using infrared bands, unique to the deuterated or hydrogenated sample, the relaxation of ends versus middle of the polymer chain can be monitored. The essential feature of the reptation models is that relaxation occurs from the ends of the chains first. Experimental results show: relaxation of the chain ends is more rapid than relaxation of the central portion of the chain, orientation of the chain ends increases linearly with total elongational strain, orientation increases with polymer molecular weight, and the relaxation of overall chain orientation at long times follows stress relaxation, which is in agreement with the classical "stress-optical law".

41382 **(DOE/ER/45161—3) Low stress brittle fracture in polymers: Annual technical progress report.** Brown, N. (Pennsylvania Univ., Philadelphia (USA). Dept. of Materials Science). 13 Jul 1987. Contract FG02-84ER45161. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012823.

A comparative investigation was made on the difference in slow crack growth behavior of a linear polyethylene and an ethylene-hexene co-polymer with 4.8 butyle branches per 1000 carbon atoms. Whereas the kinetics of initiation were linear in time, for the linear PE they were logarithmic for the copolymer; whereas a critical COD governs the beginning of crack growth in linear PE, the incubation time for crack growth in the co-polymer is about 0.6 of the time for complete failure. The difference between the morphologies of these materials fitted the observed difference in kinetic behavior. Based on the kinetics of damage initiation for ductile failure and brittle failure by slow crack growth, equations were developed for determining the critical time and stress for the ductile-brittle transition at a given defect and temperature.

41383 **(DOE/ER/45224—3) Theory of defects in non-metallic solids: Progress report, 1 August 1986 to 31 July 1987.** Kunz, A.B. (Michigan Technological Univ., Houghton (USA). Dept. of Physics). Jul 1987. Contract FG02-85ER45224. 29p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87012862.

A general method based upon ab initio quantum mechanics and also using the concepts of Mott and Littleton in 1938 are being implemented to study point defects and impurities in nonmetals. This model treats the impurity electronic structure and the lattice response to the impurity in a self-consistent way. Thus charge states of defects and impurities are readily studied as is the energy stability of the several states of charge. This project has resulted in a Fortran computer code called ICECAP to implement these ideas. A functioning code has been generated to implement these ideas. Refinement of this code is still needed. Basic concepts have now been validated in calculations. The perfect lattice limit, for example, obtains proper excitonic excitation and binding energies (accurate to 0.1 eV) as well as accurate predictions of lattice constant. Such

studies have been performed on several alkali halides and MgO. The first complete defect study, for Cu impurity in NaF, is also complete. Studies on the V/sub k/ center in LiF are underway as are studies of the self-rtrapped exciton in this system.

41384 **(EFI—826(53)-85) Behaviour of the hard part of γ-radiation of 4.4 GeV electrons in an orientated diamond crystal.** Agan'yants, A.O.; Vartanov, Yu.A.; Vartapetyan, G.A. (Erevanskij Fizicheskij Inst. (USSR)). 1985. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702677.

The measurement results for the spectrum of γ-quanta in the energy range 0.03-4.0 GeV, emitted by 4.4 GeV electrons that pass through a 100 m thick diamond crystal at small angles with respect to the plane (110) and axis [100] are reported. At the electron incidence angles $\Theta=0$ and $\Theta=3x10^{-4}$ rad relative to the axis one can observe a considerable (as compared to a disoriented crystal) intensification of the radiation yield up to E/sub γ/=2 GeV; at E/sub γ/ > 2 GeV the γ-quanta yield is suppressed by 20-30%. In the case of plane the anomalous behaviour is less pronounced.

41385 **(EFI—862(13)-86) Stimulated emission of photoexcited polarized electrons from GaAs.** Derbenev, Ya.S.; Melikyan, R.A. (Erevanskij Fizicheskij Inst. (USSR)). 1986. 14p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702705.

The influence of electric field on the emission of photoexcited polarized electrons is investigated. The thermalization of excited electrons is shown to be prevented at the field intensity in semiconductor of about 3 kV/cm. As a consequence the quantum yield grows up to unity. With the increase of the output energy of electrons the effective operation time of photocathode also increases.

41386 **(IS-T—1309) A study of deposition conditions and hydrogen motion in rf sputtered hydrogenated amorphous silicon.** Albers, M.L. (Ames Lab., IA (USA)). Jun 1987. Contract W-7405-ENG-82. 158p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE87012073.

a-Si:H films were prepared by rf sputtering in He/H_2, Ar/H_2, and Xe/H_2 atmospheres. The rf power used for deposition was varied from 0.27 to 3.3 W/cm². The films were characterized. The deposition rates of these films were found to vary linearly with deposition rates predicted from known sputtering yields. Total hydrogen concentration agreed with a kinematic model for hydrogen incorporation. The concentration of silicon atoms bonded to more than one hydrogen atom agreed with a random statistical model. Samples prepared in an Ar/H_2 atmosphere above 2.2 W/cm² were of the highest quality. Samples consisting of alternating layers of high and low hydrogen concentration were also prepared. These samples were confirmed to be multilayers. Thermal annealing showed that hydrogen does not diffuse, but rather effuses out of the sample, at elevated temperatures. These experiments also indicated that silicon-hydrogen bonds in rf sputtered a-Si:H are stronger than silicon-hydrogen bonds in glow discharge produced a-Si:H.

41387 **(JAERI-M—86-141) Development of radiation resistant grease.** Arakawa, K.; Hayakawa, N.; Yoshida, K.; Nakanishi, H.; Soda, T.; Yagi, T. (Japan Atomic Energy Research Inst., Tokyo). Oct 1986. 49p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. File Number DE87702624.

The radiation resistant greases have been developed. The thickeners were bentonite (B), silicagel (Si), and urea (U), and base oils were m-(m-phenoxyphenoxy)diphenyl (4P), alkyl-diphenyl ether (DA), and mixed oil (4P and DA). The radiation resistance of newly developed greases were evaluated by the change of grease properties as penetration, oil separation and free acid. Penetration and oil separation changes of 4P-B grease (NLGI No.2) were very small up to 30 MGy. It has higher radiation resistance than any other commercial greases. NLGI No.0 grease which is prepared by modifying 4P-B showed excellent stability to radiation up to 100 MGy. The grease improving its low-temperature properties by using the mixed oil instead of 4P, is usable until 80 MGy.

41388 **(JAERI-M—86-145) Low cycle fatigue on isotropic fine-grained graphite.** Ishiyama, S.; Oku, T. (Japan Atomic Energy Research Inst., Tokyo). Oct 1986. 32p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. File Number DE87702627.

Low cyclic fatigue tests of isotropic fine-grained graphite IG-11 were performed at the stress ratio of 0.5, 0.0, -1.0, -3.5, $+\infty$ .1/0.7, 1/0.3. The best fitting S-N curves obtained by several statistic analysis methods were compared and the effects of stress ratio and specimen size on fatigue strength were discussed and the following conclusions were obtained; 1) The best fitting S-N curve obtained by Price's method showed comparatively better in data fitting than the other methods. 2) The fatigue strength decreased as the decrease of stress ratio. The drastic decrease of fatigue strength was observed in the case of R = -3.5. The reason is that the effect of pre-compressive stress in first fatigue cycle induces the decrease of tensile strength. 3) The effect of specimen size on fatigue strength in the case of $R = +\infty$ was due to the dependence of static strength and the process of fatigue damage on specimen size. 4) The mechanism of fatigue in graphite was well understood assuming that fatigue fracture of graphites were occurred when the stress intensity factor reaches to the fracture toughness value in the process of crack extension.

41389 **(JINR-R—14-86-555) Neutron diffraction refinement of hydrogen position in $CsHSO_4$ crystal at room temperature.** Balagurov, A.M.; Beskrovnyj, A.I.; Sangaa, D.; Datt, I.D. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1986. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702842.

The refinement of hydrogen position in $CsHSO_4$ crystal has been performed on the basis of neutron diffraction data. It is shown that the protons binding the SO_4 tetrahedra in a chain along the b-vector axis are shifted antiparallely in the neighbouring chains. As a consequence, the lattice periodicity (compared with heavy atom periodicity) increases twice along c-vector. The crystallographic data on $CsHSO_4$ at room temperature are the following: the space group is $P2_1/c$, a=8.223 (4) A, b=5.814 (3) A, c=10.99 (1) A, β=119.4 (1) deg, Z=4. The birth of an antiferroelectric phase in CsH_2PO_4 for P=3.3 kbar, T <or approx. -149 deg C suggests the possibility of appearence of this phase in $CsHSO_4$ already at room temperature. 18 references, 4 figures, 1 table.

41390 **(Juel—2083) Frozen orientation disorder and rotation excitation in solid mixtures of methane and krypton (neutron diffraction experiments).** Grondey, S. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Festkoerperforschung; Technische Hochschule Aachen (Germany, F.R.)). Sep 1986. 199p. (In German). NTIS, PC E14; Available from NTIS as TIB/B87-09409.

The effect of a statistical replacement of CH/sub 4/ molecules by Kr atoms on the rotational states in solid methane has been examined. Obviously the anisotropic molecular interaction (octopole-octopole interaction) is disturbed in a way analogous to magnetic systems with random internal fields. Inelastic neutron scattering experiments on solid mixtures (CH/sub 4/)/sub 1-x/Kr/sub x/ with $0 \leq x \leq 0.35$ have been carried out, and simple models have been developed to interpret the spectra. (orig./BHO).

41391 **(K/ETAC—5) Compression failure of graphite/epoxy rings under strain control loading.** Blake, H.W. (Oak Ridge Gaseous Diffusion Plant, TN (USA). Enrichment Technology Applications Center). Jun 1987. Contract AC05-84OT21400. 8p. (CONF-8709112—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE87012036.

From Joint symposium on composite materials science and engineering; Newark, DE, USA (23 Sep 1987).

Composite rings of several graphite/epoxy materials were subjected to external pressure in a test fixture designed to provide strain control. The fixture suppresses the structural buckling modes of failure of the ring thus permitting thinner rings to be tested to their material strength limit without instability. Several failure modes are identified, and results for two materials are compared with tests on the same materials using flat specimens.

41392 (KFK—4074) AC field loss measurements of technical superconductors. Tabarsi, D. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Technische Physik; Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Elektrotechnik). Dec 1986. 112p. (In German). NTIS, PC E11; Available from NTIS as TIB/B87-09406.

AC field loss measurements were performed between 1.5 K to 4.2 K on technical superconductor systems (NbTi, Nb/sub 3/Sn) up to max. 3 T, which are needed to build superconducting magnets used for the fusion magnet technology (e.g. EURATOM-LCT-Coil). To perform loss measurements two pulsed magnet facilities, mutually complemented were installed and 3 independent loss measurement methods were used. This work presents results in 6 influence regions of the electromagnetic losses, i.e. the field and frequency dependencies, geometrical length effects (transposition), angle dependency, loss effects for superimposed pulsed fields and the temperature dependency of the AC field losses.

41393 (LA-UR—87-2337) New theories for smectic and nematic liquid crystalline polymers. Dowell, F. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 11p. (CONF-870786—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013154.

From International conference on liquid crystal polymers; Bordeaux, France (20 Jul 1987).

A summary of results from new statistical-physics theories for both backbone and side-chain liquid crystalline polymers (LCPs) and for mixtures with LCPs is presented. Thermodynamic and molecular ordering properties (including odd-even effects) have been calculated as a function of pressure, density, temperature, and molecule chemical structures (including degree of polymerization and the following properties of the chemical structures of the repeat units: lengths and shapes, intra-chain rotation energies, dipole moments, site-site polarizabilities and Lennard-Jones potentials, etc.) in nematic and multiple smectic-A LC phases and in the isotropic liquid phase. These theories can also be applied to combined LCPs. Since these theories have no ad hoc or arbitrarily adjustable parameters, these theories have been used to design new LCPs and new solvents and to predict and explain properties.

41394 (MINTEK-M—307) Phase relations in the system nickel-copper-sulphur-ruthenium at 1200°C. Nell, J. (Council for Mineral Technology, Randburg (South Africa)). 31 Mar 1987. 12p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87900932.

Dry sulphide experiments in the system copper-nickel-sulphur-ruthenium were carried out at 1200°C in an investigation of the influence of ruthenium on the slow cooling of a UG-2-type matte. Laurite (RuS_2), ruthenium metal, and two ruthenium-nickel alloys were found to be the only ruthenium-bearing phases that are stable under the experimental conditions. The resulting phase diagram indicates that a ruthenium-rich ruthenium-nickel alloy will coexist with a sulphide liquid during the slow cooling of a ruthenium-rich UG-2-type matte.

41395 (SAND—87-0910C) Ion-implantation-induced stress in glasses: Variation of damage mode efficiency with changes in glass structure. Arnold, G.W. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 14p. (CONF-870783—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013523.

From Radiation effects in insulators-4 conference; Lyon, France (6 Jul 1987).

Ion implantation induces lateral stress in glass due to the volume dilatation in the implanted near-surface region. Cantilever-beam experiments allow these quantities to be measured as a function of fluence. For fused silica the stress data for various incident ions are found to scale with atomic collision energy deposition. In sharp contrast, Pyrex (alkali-borosilicate) glass, $(1-x)(Na,K)_2O \cdot xB_2O_3 \cdot 3SiO_2$ glass, and a soda-lime (microscope slide) glass, yield stress values which scale with energy deposition into electronic processes. More significantly, this mode of damage production is dominant for the nuclear waste glasses PNL 76-68 and SRP. The void space in fused silica allows room for displaced Si and/or O. For the complex alkali-containing silicates, the interstitial volume is restricted. In the latter case, the probability increases that permanent defects can be formed by ionization-induced bond-breaking and network relaxation. These data imply that alpha-particle ionization energy deposition may be an important factor in nuclear waste glass radiation damage production, but the magnitude of this contribution has not yet been evaluated.

41396 (SAND—87-0911C) Ambient hydration of near-surface region in H/D implanted fused silica. Arnold, G.W. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 16p. (CONF-870783—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012973.

From Radiation effects in insulators-4 conference; Lyon, France (6 Jul 1987).

Fused silica glass implanted with 20 keV H/D ions is characterized by a saturation concentration of 1.0-1.5 x 10^{21}H/D cm^{-3} as determined by elastic recoil detection (ERD). Re-measurement of implanted samples after a lapsed time of ~6 y revealed an enhanced hydration level over the implant range (~2-3x). These results were verified on newly implanted 20 keV-H samples which were exposed to humid air (90% RH/70°C) for 2 periods of approximately 4 days each. The initial implant concentration saturation values can be understood as representing the maximum number of Si-OH sites available and is in agreement with experimental gas-loading values and are of the same order as the theoretical number of such sites. The increased values seen upon exposure to humid air are interpreted as due to the in-diffusion of molecular water and reaction with strained bonds to form Si-OH entities at sites near the surface in the implantation-altered structure.

41397 (SAND—87-0917C) Shock-induced melting of a KCl:LiCl eutectic powder as determined from electrochemical response measurements. Graham, R.A.; Morosin, B.; Bush, D.M. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 5p. (CONF-870753—40). NTIS, PC A02. File Number DE87012719.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

Shock-induced melting of powder compacts of a eutectic of KCl and LiCl has been investigated in an electrochemical cell in which the eutectic serves as the electrolyte with an anode of a lithium-silicon alloy and a cathode with a mixture of FeS_2, the eutectic and silicon dioxide. The cell remains inactive into low impedance electrical loads until the powder is melted either under shock pressure or upon release of pressure. Melt behavior is clearly indicated in time-resolved electrochemical voltage measurements and the degree of melt is sensitive to the starting powder density which controls the increase in temperature. The indicated electrolytic conductivity suggests that melting is not complete in either the shock or release state. Such electrochemical response measurements provide capability for direct studies of melting behavior, for determination of Gibbs potentials of reactions and their kinetics while under shock compression.

41398 (SAND—87-1894C) Structure of sol-gel-derived inorganic polymers: 2, Silicates and borates. Brinker, C.J.; Bunker, B.C.; Tallant, D.R.; Ward, K.J.; Kirkpatrick, R.J. (Sandia National Labs., Albuquerque, NM (USA); Illinois Univ., Urbana (USA). Dept. of Geology). 1987. Contract AC04-76DP00789. 22p. (CONF-870410—36). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013068.

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

Many of the structural features of sol-gel-derived inorganic polymers are rationalized on the basis of the stability of the M-O-M condensation products in their synthesis environments. Structures which emerge in solution reflect a successive series of hydrolysis, condensation and, depending on the acid or base concentration, restructuring reactions. M-O-M bonds which are unstable with respect to hydrolysis or alcoholysis are generally absent. During consolidation, the condensation process continues within a very stiff matrix in a relatively inert environment. Under these conditions, metastable species may form which are temporarily stabilized by the high matrix viscosity and the absence of water and alcohol. 54 refs., 8 figs.

41399 **(UCRL—95287) An optically strobed sample and hold circuit.** McConaghy, C. (Lawrence Livermore National Lab., CA (USA)). Jan 1987. Contract W-7405-ENG-48. 6p. (CONF-870114—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011877.

From IEEE/OSA topical meeting on picosecond electronics and optoelectronics; Lake Tahoe, NV, USA (14 Jan 1987).

Radiation damaged photoconductors have been shown to be useful devices for sampling repetitive electrical signals with time resolution to less than a picosecond. In previous work, the signal being sampled has generally had to repeat inorder to be averaged by a lock-in amplifier for detection. In contrast, the circuit described in this paper is designed to make one sample on a non-repetitive signal with a 10 picoseconds aperture and then hold this sample for a microsecond. The hold time only needs to be long enough for the signal to be A to D converted. This circuit was designed as a prototype with the intent of integrating a number of these circuits in the future for making multiple samples, offset in time, on a single electrical transient signal and thereby capture the transient. This paper will be concerned with the design, fabrication and testing of one of these optically strobed sample and hold circuits.

41400 **(UCRL—96160) Optical properties of Cr^{3+} in fluoride hosts.** Payne, S.A.; Chase, L.L.; Krupke, W.F. (Lawrence Livermore National Lab., CA (USA)). Jun 1987. Contract W-7405-ENG-48. 5p. (CONF-8708100—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011924.

From International conference on luminescence; Beijing, China (17 Aug 1987).

This paper presents information which suggests that the lattice relaxation around a Cr^{3+} impurity must be accounted for when interpreting the optical spectra of the ion. Special attention is given to fluoride lattices in which the cation radius is larger than that of Cr^{3+}.

41401 **Proposal for strained type II superlattice infrared detectors.** Smith, D.L.; Mailhiot, C. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Applied Physics;* **62**: No. 6, 2545-2548(15 Sep 1987).

We show that strained type II superlattices made of InAs-Ga/sub 1-//sub x/In/sub x/Sb x—0.4 have favorable optical properties for infrared detection. By adjusting the layer thicknesses and the alloy composition, a wide range of wavelengths can be reached. Optical absorption calculations for a case where λ/sub c/—10 μm show that near threshold the absorption is as good as for the HgCdTe alloy with the same band gap. The electron effective mass is nearly isotropic and equal to 0.04 m. This effective mass should give favorable electrical properties, such as small diode tunneling currents and good mobilities and diffusion lengths.

41402 **High-fluence ion damage effects in Ar-implanted (InGa)As/GaAs strained-layer superlattices.** Myers, D.R.; Arnold, G.W.; Hills, C.R.; Dawson, L.R.; Doyle, B.L. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Applied Physics Letters;* **51**: No. 11, 820-822(14 Sep 1987).

We have characterized (InGa)As/GaAs strained-layer superlattices (SLS's) that have been implanted with 300 keV argon ions at room temperature for fluences sufficient to induce precipitous stress relief in the implanted composite. SLS compositional modulation is lost due to ion beam mixing over much of the ion range; however, the implanted regions remain crystalline despite extensive damage near the mean ion range. High-density dislocation networks are found near the substrate-buffer interface after precipitous stress relief and are correlated with the occurrence of the effect.

41403 **Photoconductivity in $CuInSe_2$ thin films.** Ramanathan, V.; Datta, T.; Noufi, R. (Solar Energy Research Institute, 1617 Cole Boulevard, Golden, Colorado 80401). *Applied Physics Letters;* **51**: No. 10, 746-748(7 Sep 1987). Contract AC02-83CH10093.

We report the photoconductivity spectra of $CuInSe_2$ thin films of precisely defined compositions that are required to fabricate high-efficiency CdS/$CuInSe_2$ thin-film solar cells. The Cu-deficient, high-resistivity $CuInSe_2$ layer is found to be much more photoconducting than the stoichiometric, low-resistivity $CuInSe_2$. We show that the spectral dependence of the photoconductivity of the composite $CuInSe_2$ layer is intimately related to the spectral response of the solar cells.

41404 **Electron mobility in p-GaAs by time of flight.** Ahrenkiel, R.K.; Dunlavy, D.J.; Greenberg, D.; Schlupmann, J.; Hamaker, H.C.; MacMillan, H.F. (Solar Energy Research Institute, Golden, Colorado 80401). *Applied Physics Letters;* **51**: No. 10, 776-778(7 Sep 1987).

The minority-carrier mobility of electrons in metalorganic chemical vapor deposition grown p-GaAs has been measured by a diffusion time-of-flight technique. Doping levels of 1×10^{17} and 2×10^{18} cm^{-3} were investigated. The measured mobilities were about 2900 and 1300 cm^2/V s, respectively. The minority-carrier mobilities are lower than the expected majority-carrier mobilities at the same doping levels. The lower mobility is caused by heavy-hole scattering.

41405 **Interfacial interactions of evaporated iridium thin films with (100) GaAs.** Yu, K.M.; Sands, T.; Jaklevic, J.M.; Haller, E.E. (Center for Advanced Materials and Engineering Division, Lawrence Berkeley Laboratory and University of California, Berkeley, California 94720). *Journal of Applied Physics;* **62**: No. 5, 1815-1820(1 Sep 1987). Contract AC03-76SF00098.

We report a systematic study of thermally activated solid phase reactions between (100) GaAs and evaporated iridium thin films (100 and 550 A thick). The investigation is carried out with Rutherford backscattering spectrometry, x-ray diffraction, and transmission electron microscopy. Interfacial interactions are observed after annealing the system at temperatures higher than 500°C. Complete reaction at 700°C results in the formation of Ir_3Ga_5 and $IrAs_2$ phases. Intermediate phase IrGa is formed in the annealing temperature range of 500—650°C. Vertical phase segregation is also observed with the $IrAs_2$ phase at the interface and the Ir-Ga phases on the surface layer. Specific information on the reaction kinetics, transformation, and structures of different phases and phase distributions are also discussed. Comparisons with interfacial reactions of other near noble metal/GaAs systems are presented. Based on the metallurgical information obtained, the potential applications of this contact system are suggested.

41406 **Light scattering from a binary-liquid entanglement gel.** Xia, K.; Maher, J.V. (Department of Physics and Astronomy, University of Pittsburgh, Pittsburgh, Pennsylvania 15260). *Physical Review* [*Section*] *A: General Physics;* **36**: No. 5, 2432-2439(1 Sep 1987).

Light-scattering experiments have been carried out on an entanglement gel with a binary-liquid mixture as solvent. The onset temperature for critical opalescence has a composition dependence which is similar to the coexistence curve of the free-liquid mixture. This system resembles previously reported work on the cross-linked gel polyacrylamide in two ways: (1) As temperature is lowered toward the critical temperature of the free-liquid mixture, the binary-fluid gel exhibits a strong and increasing light scattering over a broad temperature region of several kelvins, and (2) no appreciable temporal fluctuations are observed throughout this temperature region. Two added features are observed in the present, entanglement-gel measurements: (a) Gel samples with solvent composition both near and off the critical composition of the free-liquid mixture exhibit similar light-scattering behavior, and (b) a Lorentzian-squared fit to the light-scattering angular distributions yields a characteristic wave number which does not change with temperature and an amplitude which shows a very strong dependence on the temperature.

41407 **III—V strained layer supperlattices for long-wavelength detector applications: Recent progress.** Osbourn, G.C.; Dawson, L.R.; Biefeld, R.M.; Zipperian, T.E.; Fritz, I.J.; Doyle, B.L. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **5**: No. 5, 3150-3152(Sep 1987).

Recent results of research on III—V InAsSb strained-layer superlattices are reviewed. Successful growth of microcrack-free InSb/InAsSb strained-layer superlatties has been achievedf by both molecular-beam epitaxy and metal—organic chemical vapor deposition techniques. The results provide encouraging indications that these III—V materials have superior structural stability to that of the Hg-rich HgCdTe alloys.

41408 **Electron energy-loss studies on radio frequency sputtered a-Ge/sub 1-//sub x/C/sub x/:H films.** Shinar, R.; Shinar, J.; Wu, H.; Shanks, H.R. (Microelectronics Research Center, Department of Physics and Ames Laboratory-USDOE, Iowa State University, Ames, Iowa 50011). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **5**: No. 5, 2804-2808(Sep 1987).

Valence-band and core level electron energy-loss spectroscopy (EELS) were used to study rf sputter deposited hydrogenerated amorphous germanium carbide films (a-Ge/sub 1-//sub x/C/sub x/:H, $0 \leqq x \leqq 1$). The optical gap of the films ranged from 0.8—1.0 eV in a-Ge:H to 1.2—2.3 eV in a-C:H. Valence-band EELS of clean sputter etched a-Ge and a-Ge:H films ($x = 0$), as compared to that of Ar^+ sputter etched Ge(111) and hydrogen covered single crystals of Ge, respectively, indicated preferential sputtering of hydrogen by Ar ions, in contrast to recent observations on rf sputter deposited a-Si:H, where Ar^+ etching did not cause complete depletion of hydrogen from the surface. In a-Ge/sub 1-//sub x/C/sub x/:H alloy films ($0 < x < 1$) loss peaks related to carbon and Ge—C bonds were identified. Auger analysis of as prepared a-C and a-C:H films ($x = 1$) indicated relatively clean surfaces. Typically, only 1%—2% oxygen was found on the surfaces. EELS experiments indicated graphitelike surface structures. In addition, the hydrogen bulk content had no influence on the spectra, suggesting that the surfaces of the a-C:H films were hydrogen depleted. The Auger carbon line shape further confirmed this assumption.

41409 **Paramagnetic point defects in boron-implanted Hg/sub 0.7/Cd/sub 0.3/Te and CdTe.** Bowman R.C. Jr.; Venturini, E.L.; Witt, S.N. (Chemistry and Physics Laboratory, The Aerospace Corporation, Los Angeles, California 90009). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **5**: No. 5, 3171-3174(Sep 1987).

This paper describes the initial observations of electron paramagnetic resonance (EPR) spectra from Hg/sub 0.7/Cd/sub 0.3/Te and CdTe after implantation with boron ions. Sharp and nearly isotropic EPR signals with the free-electron g values were easily detected at low temperatures (i.e., $\leqq$ 78 K) when the boron ion implant dose was 1×10^{16} ions/cm^2 or larger. For identical implant conditions, more intense signals and narrower peaks were obtained from Hg/sub 0.7/Cd/sub 0.3/Te samples when compared to the spectra for CdTe. However, the g factors for all implanted Hg/sub 1-//sub x/Cd/sub x/Te samples appear to be equivalent and are very similar to the values reported for the dangling-bond defects in other ion-implanted semiconductors. The EPR spectra produced by the boron implants do not seem to correspond to either the degenerate conduction electron bands that form in ion-implanted Hg/sub 1-//sub x/Cd/sub x/Te or the shallow donor states previously found in chemically doped CdTe. When implanted crystals are cooled below 4 K, partially resolved two-component line shapes are observed at some orientations. Increasing temperature causes these two-component lines to collapse into nearly Lorentzian line shapes with temperature-dependent widths. This behavior is consistent with a thermally activated process by which the paramagnetic spins hop between inequivalent locations.

41410 **Phosphor film characterization measurements in the vacuum UV using a multichannel detector.** Fahr, A.; Laufer, A.H.; Braun, W. (Department of Energy, Office of Basic Energy Sciences, Division of Chemical Sciences, Washington, DC 20545). *Applied Optics;* **26**: No. 16, 3428-3433(15 Aug 1987).

A linear microchannel plate-reticon array detector is used to characterize phosphor films. These films upconvert vacuum UV radiation into the detector's sensitive spectral range (wavelengths $>$ 350 nm). The methodology for measuring the sensitivity as well as the angular dependence of fluorescence of films is described, and absolute as well as relative efficiencies for several phosphors is given. The use of this device circumvents some of the problems inherent in such characterization measurements.

41411 **High-pressure structural and electronic properties of carbon.** Fahy, S.; Louie, S.G. (Department of Physics, University of California, Berkeley, California 94720 and Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Physical Review [Section] B: Condensed Matter;* **36**: No. 6, 3373-3385(15 Aug 1987). Contract AC03-76SF00098.

The high-pressure properties of carbon in eight different structures are calculated using an ab initio pseudopotential local-orbital method. In particular, the structural properties of hexagonal diamond and variation of its fundamental band gap with pressure are calculated for the first time. The variation of the fundamental gap in hexagonal diamond is found to have the opposite sign to that in cubic diamond, although the cubic and hexagonal forms have almost identical structural properties. Among the structures examined, diamond is found to transform under hydrostatic pressure first to the fourfold coordinated bc-8 (or Si-III) structure. The bc-8 form is favored at pressures greater than 11.1 Mbar. This is a slightly lower transformation pressure than that recently calculated using the pseudopotential plane-wave method. The sixfold coordinated structures, simple cubic and β-tin, are found at low pressure to be kinetically unstable, transforming spontaneously, without an energy barrier, into the cubic diamond structure. This result suggests that sixfold coordination of liquid carbon will be unlikely to occur at moderate pressure and temperature. Similarly, sixfold coordination is not expected in carbon clusters. A method of fully utilizing crystal symmetry to reduce the amount of computation in evaluating two- and three-center integrals needed in the local-orbital method is developed for the present calculations.

41412 **Hartree-Fock energies for NaF_6 cluster simulations of Na^+ hole states in the NaF crystal.** Green, T.A.; Jennison, D.R.; Melius, C.F.; Binkley, S.J. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Physical Review [Section] B: Condensed Matter;* **36**: No. 6, 3469-3471(15 Aug 1987). Contract AC04-76DP00789.

In order to provide ab initio wave functions for the evaluation of intra- and interatomic Auger rates in the NaF crystal, new open-shell restricted Hartree-Fock calculations have been performed for several Na^+ hole states of an (NaF_6)/sup 5-/ cluster embedded in a cubic array of point ions. The basis sets are described and the self-consistent-field ionization energies ΔE/sub SCF/ are compared with values available from the literature. It is noted that appreciable valence electron charge is transferred between the F and Na atoms upon Na hole creation.

41413 **Role of d orbitals in valence-band offsets of common-anion semiconductors.** Wei, S.; Zunger, A. (Solar Energy Research Institute, Golden, Colorado 80401). *Physical Review Letters;* **59**: No. 1, 144-147(6 Jul 1987). Contract AC02-77CH00178.

We show through all-electron first-principles electronic structure calculations of core levels that, contrary to previous expectations, the valence-band offsets in the common-anion semiconductors AlAs-GaAs and CdTe-HgTe are decided primarily by intrinsic bulk effects and that interface charge transfer has but a small effect on these quantities. The failure of previous models is shown to result primarily from their decision to omit cation d orbitals.

41414 **Band electronic structure study of La_2CuO_4 and the high-temperature superconductor La/sub 2-x/M/sub x/CuO_4: non-peierls nature of the tetragonal to orthorhombic distortion of La_2CuO_4 and its implications.** Whangbo, M.H.; Evain, M.; Beno, M.A.; Williams, J.M. (North Carolina State Univ., Raleigh). *Inorganic Chemistry;* **26**: No. 12, 1829-1830(17 Jun 1987). Contract FG05-86ER45259;W-31-109-ENG-38.

The results of studies to determine how the dopant, M, an alkaline earth metal causes high-critical temperature superconductivity in La/sub 2-x/M/sub x/CuO_4 are reported. Tight-binding band calculations were carried out on La_2CuO_4 and on a single CuO_4 layer of La/sub 2-x/M/sub x/CuO_4. Results of one-electron band

electronic structure calculations were found to complement findings of self-consistent-field band studies recently reported by other authors. 1 figure, 31 references.

41415 **Band electronic structure of the high-temperature (T/sub c/ > 90 K) superconductor orthorhombic $YBa_2Cu_3O_7$. 2. Effect of the capping-oxygen displacement on the interaction of the CuO_2 layers with CuO_3 chains, the Fermi surface dimensionality of the CuO_3 chain band, and the valence fluctuations of the copper atoms.** Whangbo, M.H.; Evain, M.; Beno, M.A.; Williams, J.M. (North Carolina State Univ., Raleigh). *Inorganic Chemistry;* **26**: No. 12, 1832-1834(17 Jun 1987). Contract FG05-86ER45259;W-31-109-ENG-38.

Recently reported powder neutron diffraction studies identify the superconducting Y-Ba-Cu-O phase as orthorhombic YBa_2Cu_3O/sub 7-y/ (y ~ 0.19) which contains two-dimensional structural units of composition Ba_2Cu_3O/sub 7-y/$^{3-}$. Within each Ba_2Cu_3O/sub 7-y/$^{3-}$ slab, each copper atom is capped by an oxygen to form a Cu-O-Cu-O-Cu bridge perpendicular to the Ba_2Cu_3O/sub 7-y/$^{3-}$ slab. In this paper, the effect of the O atom displacement is assessed by performing tight-binding band calculations. The slight displacement of the capping oxygen atom from its equilibrium position was found to give slight fluctuations in valence of the copper atoms, to cause interaction between two separated CuO_2 layers within each Ba_2Cu_3O/sub 7-y/$^{3-}$ slab, and to result in a change in the Fermi surface dimensionality of the CuO_3 chain band. It seems to be evident that the Cu-O-Cu-O-Cu bridging theory with the help of lattice vibrational modes involving the capping O atoms can explain the superconductivity that occurs within the Ba_2Cu_3O/sub 7-y/$^{3-}$ slabs.

41416 **High-T/sub c/ super conductors: selective preparation and characterization of tetragonal and orthorhombic (93 K superconductor) phases of YBa_2Cu_3O/sub 7-x/.** Kini, A.M.; Geiser, U.; Kao, H.C.I.; Carlson, K.D.; Wang, H.H.; Monaghan, M.R.; Williams, J.M. (Argonne National Lab., IL). *Inorganic Chemistry;* **26**: No. 12, 1834-1836(17 Jun 1987). Contract W-31-109-ENG-38.

It has been previously reported that two structures, both presumably superconducting, are found for YBa_2Cu_3O/sub 7-x/. This paper reports the advantages of the coprecipitation method for the preparation of YBa_2Cu_3O/sub 7-x/ (x ~ 0.1) and that two phases, orthorhombic or tetragonal, can be selectively obtained depending of the sample cooling rate subsequent to oxygen annealing. It was also found that superconductivity at 93aK exists only in the orthorhombic phase and that the electrical properties of the tetragonal phase exhibit variations from sample-to-sample ranging from a semiconductor to a lower T/sub c/ superconductor with a broad transition occurring at 60K. It has been demonstrated in this preparation and evaluation of properties that the cooling rate subsequent to oxygen annealing is a very critical factor in obtaining the high T/sub c/ superconducting orthorhombic phase. 13 references, 2 figures.

41417 **Pseudomorphic InGaAs/AlGaAs modulation-doped FET's with reduced low-frequency noise and thermally stable performance.** Liu Shihming; Das, M.B.; Peng, C.K.; Klem, J.; Henderson, T.; Kopp, W.; Morkoc, H. (Pennsylvania State Univ., University Park, USA. Dept. of Electrical Engineering; Pennsylvania State Univ., University Park, USA. Materials Research Lab.; Illinois Univ., Urbana, USA. Coordinated Science Lab.). *Journal of Crystal Growth;* **81**: No. 1-4, 359-367(Feb 1987). (CONF-8609295—).

From 4. international conference on molecular beam epitaxy (MBE-4) and exhibition; York, UK (7 Sep 1986).

A high-performance MODFET structure grown by MBE with the incorporation of a single quantum well In/sub 0.15/Ga/sub 0.85/As layer for the transport of 2D electron gas has been critically examined for its thermal stability at 80 K and low-frequency noise from 10/sup -2/ to 10/sup 8/ Hz. Experimental results indicate that the behavior of this device in both these respects is much superior when compared with the same behavior of conventional MODFET's. A maximum low-field carrier mobility of 29,000 cm/sup 2//s at 80 K and an average carrier saturation velocity of 2 x 10/sup 7/ cm/s at 300 K in a 1 μm gate device clearly indicate that the quality of the pseudomorphic quantum well (InGaAs) layer is either comparable or better than that of the usual GaAs buffer layer. The deep level spectra, obtained through photo-FET measurements, and the low-frequency noise spectra at different temperatures obtained for the new pseudomorphic and conventional MODFET's have clearly indicated that contributions from various deep levels present in the new structure are significantly reduced.

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4001 Analytical And Separations Chemistry

REFER ALSO TO CITATION(S) 40357, 40397, 40472, 40474, 40607, 40622, 40707, 41527, 41528, 41529, 41532, 41533, 41534, 41535, 41536, 41539, 41541, 41638, 41657, 41658

41418 **(BNL—39996) A versatile two/four crystal monochromator for x-ray absorption spectroscopy.** Heald, S.M. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 16p. (CONF-870610—6). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012483.

From 5. national synchrotron radiation instrumentation conference; Madison, WI, USA (21 Jun 1987).

This paper describes a unique x-ray monochromator which can employ either two or four crystal reflections. In the four-crystal mode two counter-rotating pairs of crystals provide a high resolution dispersive arrangement with a fixed output beam. In this arrangement the basic functions of the monochromator are separated: the first crystal takes the heat load, the second and third crystals provide energy resolution, and the fourth crystal can be bent for sagittal focusing. The advantages of this design for use with a collimating mirror is discussed along with a comparison of two and four crystal characteristics. Operation in both two and four crystal modes is described along with procedures for maintaining crystal alignment.

41419 **(IAEA-RL—135) Nuclear techniques for analysis of environmental samples. Working papers prepared in connection with a consultants' meeting.** (International Atomic Energy Agency, Vienna (Austria)). Dec 1986. 239p. (CONF-8602131—). NTIS (US Sales Only), PC A11/MF A01. File Number DE87702731.

From Consultants' meeting on nuclear techniques for analysis of environmental samples; Karlsruhe, F.R. Germany (19 Feb 1986).

The main purposes of this meeting were to establish the state-of-the-art in the field, to identify new research and development that is required to provide an adequate framework for analysis of environmental samples and to assess needs and possibilities for international cooperation in problem areas. This technical report was prepared on the subject based on the contributions made by the participants. A separate abstract was prepared for each of the 9 papers. Refs, figs and tabs.

41420 **(IAEA-RL—135, pp 1-27) Charting the trends in nuclear techniques for analysis of inorganic environmental pollutants.** Braun, T. (Eoetvoes Lorand Tudomanyegyetem, Budapest, Hungary. Szervetlen es Analitikai Kemiai Intezet). Dec 1986. NTIS (US Sales Only), PC A11/MF A01. File Number DE87702731. (CONF-8602131—).

From Consultants' meeting on nuclear techniques for analysis of environmental samples; Karlsruhe, F.R. Germany (19 Feb 1986).

Publications in Analytical Abstracts in the period 1975-1984 and papers presented at the Modern Trends in Activation Analysis international conferences series in the period 1961-1986 have been used as an empirical basis for assessing general trends in research and publication activity. Some ebbs and flows in the speciality of instrumental techniques for analysis of environmental trace pollutants are revealed by a statistical analysis of the publications. 12 refs, 9 figs, 7 tabs.

41421 (IAEA-RL—135, pp 28-48) **Nuclear analytical techniques and their application to environmental samples.** Lieser, K.H. (Technische Hochschule Darmstadt, Germany, F.R. Fachbereich 8 - Anorganische Chemie und Kernchemie). Dec 1986. NTIS (US Sales Only), PC A11/MF A01. File Number DE87702731. (CONF-8602131—).

From Consultants' meeting on nuclear techniques for analysis of environmental samples; Karlsruhe, F.R. Germany (19 Feb 1986).

A survey is given on nuclear analytical techniques and their application to environmental samples. Measurement of the inherent radioactivity of elements or radionuclides allows determination of natural radioelements (e.g. Ra), man-made radioelements (e.g. Pu) and radionuclides in the environment. Activation analysis, in particular instrumental neutron activation analysis, is a very reliable and sensitive method for determination of a great number of trace elements in environmental samples, because the most abundant main constituents are not activated. Tracer techniques are very useful for studies of the behaviour and of chemical reactions of trace elements and compounds in the environment. Radioactive sources are mainly applied for excitation of characteristic X-rays (X-ray fluorescence analysis). 27 refs, 2 figs, 2 tabs.

41422 (IAEA-RL—135, pp 110-137) **New method for processing INAA results without the necessity of standards. Some examples of elemental determinations in a large variety of environmental samples.** Hemon, G.; Philippot, J.C. (Commissariat a l'Energie Atomique - IPSN. Lab. de Metrologie de l'Environnement et d'Intervention, France). Dec 1986. NTIS (US Sales Only), PC A11/MF A01. File Number DE87702731. (CONF-8602131—).

From Consultants' meeting on nuclear techniques for analysis of environmental samples; Karlsruhe, F.R. Germany (19 Feb 1986).

When neutron activation analysis is used for elemental determinations in samples taken from environment, and quite different in origin, certain questions arise: is the method absolute or relative, precise or accurate? How should objects be chosen to represent the subject studied? How should the conclusions of the measurement be used? How are the quality and intensity of the flux to be controlled? What corrections are needed for the effects of perturbing elements, uranium and boron? How sensitive is the method or - which amounts to the same thing - what is the best time to analyse an element in a given matrix? The authors attempt to answer these questions and illustrate the subject by way of a few specific examples: mineral and river water, sea and river sediments, aerosols, quartz tools, hair, nodules and Mn deposits, diamonds, wines, PWR effluents. 20 refs.

41423 (IAEA-RL—135, pp 138-158) **Isotope dilution analysis of environmental samples.** Tolgyessy, J.; Lesny, J.; Korenova, Z.; Klas, J.; Klehr, E.H. (Slovak Technical Univ., Bratislava, Czechoslovakia. Chemicotechnological Faculty; Oklahoma Univ., Norman, USA. School of Civil Engineering and Environmental Science). Dec 1986. NTIS (US Sales Only), PC A11/MF A01. File Number DE87702731. (CONF-8602131—).

From Consultants' meeting on nuclear techniques for analysis of environmental samples; Karlsruhe, F.R. Germany (19 Feb 1986).

Isotope dilution analysis has been used for the determination of several trace elements - especially metals - in a variety of environmental samples, including aerosols, water, soils, biological materials and geological materials. Variations of the basic concept include classical IDA, substoichiometric IDA, and more recently, sub-superequivalence IDA. Each variation has its advantages and limitations. A periodic chart has been used to identify those elements which have been measured in environmental samples using one or more of these methods. 36 refs, 3 tabs, 3 flow sheets.

41424 (IAEA-RL—135, pp 159-181) **Nonactivation interaction techniques in the analysis of environmental samples.** Tolgyessy, J. (Slovak Technical Univ., Bratislava, Czechoslovakia. Chemicotechnological Faculty). Dec 1986. NTIS (US Sales Only), PC A11/MF A01. File Number DE87702731. (CONF-8602131—).

From Consultants' meeting on nuclear techniques for analysis of environmental samples; Karlsruhe, F.R. Germany (19 Feb 1986).

Nonactivation interaction analytical methods are based on the interaction processes of nuclear and X-ray radiation with a sample, leading to their absorption and backscattering, to the ionization of gases or excitation of fluorescent X-ray by radiation, but not to the activation of determined elements. From the point of view of environmental analysis, the most useful nonactivation interaction techniques are X-ray fluorescence by photon or charged particle excitation, ionization of gases by nuclear radiation, elastic scattering of charged particles and backscattering of beta radiation. The significant advantage of these methods is that they are nondestructive. 37 refs, 4 figs.

41425 (IAEA-RL—135, pp 182-207) **Radioactive kryptonates in the analysis of environmental samples.** Tolgyessy, J. (Slovak Technical Univ., Bratislava, Czechoslovakia. Chemicotechnological Faculty). Dec 1986. NTIS (US Sales Only), PC A11/MF A01. File Number DE87702731. (CONF-8602131—).

From Consultants' meeting on nuclear techniques for analysis of environmental samples; Karlsruhe, F.R. Germany (19 Feb 1986).

The term "radioactive Kryptonates" is used for substances into which atoms or ions of the radioactive nuclide /sup 85/Kr are incorporated. The basis of the use of radioactive Kryptonates in analytical chemistry is that during a chemical reaction the crystalline lattice of the kryptonated carrier is destroyed, the carrier consumed, and the radioactive krypton released (radio-release method). Analysis can be made with a calibration curve or by comparison with a standard. Radio-release methods with the aid of radioactive Kryptonates as analytical reagents are very useful for the analysis of environmental samples, e.g. for the determination of air pollutants (ozone, sulphur dioxide, fluorine, hydrogen fluoride, mercury); and water pollutants (oxygen, dichromate, vanadium, hydrochloric acid, sulphur dioxide). 31 refs, 8 figs.

41426 (IAEA-RL—135, pp 208-222) **Preliminary results of an intercomparison for the determination of nutritionally important elements in human diet.** Parr, R.; Schelenz, R. (International Atomic Energy Agency, Vienna, Austria. Dept. of Research and Isotopes). Dec 1986. NTIS (US Sales Only), PC A11/MF A01. File Number DE87702731. (CONF-8602131—).

From Consultants' meeting on nuclear techniques for analysis of environmental samples; Karlsruhe, F.R. Germany (19 Feb 1986).

The primary purpose of the intercomparison was to provide participants with an opportunity to check their analytical performance in comparison with other laboratories. The results reported for the human total diet sample by different analytical techniques (e.g. neutron activation analysis, atomic absorption spectrometry, emission spectrometry, X-ray fluorescence, electrochemical methods) will be sufficiently consistent to permit its subsequent re-use as a certified reference material. In this intercomparison approx. 50 participants submitted their results for 33 trace and minor elements mainly using 6 different analytical methods and 31 different techniques. 15 figs, 2 tabs.

41427 (IAEA-RL—135, pp 223-237) **Single element methods based on combination of NAA and column chromatography - A possible solution for obtaining highly accurate results of trace element determination in environmental and other samples.** Dybczynski, R. (Institute of Nuclear Chemistry and Technology, Warsaw, Poland). Dec 1986. NTIS (US Sales Only), PC A11/MF A01. File Number DE87702731. (CONF-8602131—).

From Consultants' meeting on nuclear techniques for analysis of environmental samples; Karlsruhe, F.R. Germany (19 Feb 1986).

The role of Analytical Chemistry in the field of Environmental Protection and the significance of assuring high reliability of analytical results are briefly discussed. On the basis of data extracted from IAEA intercomparison runs it is shown that accuracy is still the main problem of contemporary trace analysis and that gross

errors occur quite frequently. It is pointed out that there is a need for methods of proven accuracy for the determination of individual elements in certain types of matrices. Such methods would be used for checking the accuracy of routine methods, and certification of the candidate reference materials. Criteria for creating highly accurate methods based on combination of activation analysis and column chromatography are proposed. Practical implementation of these principles is illustrated on the example of determination of copper traces in several certified reference materials. 23 refs, 1 fig, 5 tabs.

41428 (IAEA-RL—135, pp 49-109) **Preconcentration of traces of radionuclides with sorbents based on spherical polyurethane membrane systems in the analysis of environmental samples.** Palagyi, S.; Braun, T. (Institute of Radioecology and Applied Nuclear Techniques, Kosice, Czechoslovakia; Eoetvoes Lorand Tudomanyegyetem, Budapest, Hungary. Szervetlen es Analitikai Kemiai Intezet). Dec 1986. NTIS (US Sales Only), PC A11/MF A01. File Number DE87702731. (CONF-8602131—).

From Consultants' meeting on nuclear techniques for analysis of environmental samples; Karlsruhe, F.R. Germany (19 Feb 1986).

In the paper the importance of preconcentration and a permanent need for efficient preconcentrating agents in environmental analysis are pointed out. The increased attention is devoted to the foamed polyurethane sorbents as a novel advance in the separation chemistry. The paper has two main aims. The first is to present a survey of recent applications of unloaded and reagent loaded open-cell type resilient polyurethane foams to the separation and preconcentration of radionuclides from environmental samples. The second is to show the newest results in the use of these foams for the preconcentration and determination of traces of some mainly inorganic species in environmental samples by radioanalytical techniques. Some future possibilities of the use of polyurethane foams in trace elemental determinations in environmental analysis are also outlined. 99 refs, 11 figs, 11 tabs.

41429 **(IAEA-RL—141) Applications of short-lived activation products in neutron activation analysis of bio-environmental specimens. Documents prepared in connection with a consultants' meeting including a bibliography retrieved from the INIS database.** (International Atomic Energy Agency, Vienna (Austria)). Mar 1987. 101p. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702564.

This report discusses the advantages and disadvantages, special techniques, and actual and potential applications of neutron activation analysis (NAA) utilizing short-lived neutron-induced products, with special reference to the analysis of samples of biological and environmental origin. Attention is devoted mainly to products having half-lives in roughly the range of 10 milliseconds to 60 seconds, but with some discussion of the usefulness of even shorter-lived species, and ones with half-lives as long as a few minutes. Important aspects of the analytical methodology include sample preparation, irradiation/transfer systems, activity measurements, data processing and analytical quality assurance. It is concluded that several trace elements can be determined in bio-environmental samples (as well as in samples of industrial, geochemical and other origin). In particular, this method provides analytical possibilities for several elements (e.g. B, F, Li and V) that are difficult to determine in some matrices at trace levels by any other technique. These conclusions are illustrated in an annex by results of calculations in which the applicability of the techniques to the analysis of several biological and environmental reference materials is evaluated by means of an advance computer prediction program. The report concludes with an annotated bibliography of relevant publications (including abstracts, where available) taken from the INIS database. 6 tables.

41430 **(INIS-BR—653) Analysis of carbon stable isotope to determine the origin and migration of gaseous hydrocarbon in the Brazilian sedimentary basins.** Takaki, T.; Rodrigues, R. (Instituto Brasileiro de Petroleo, Rio de Janeiro; PETROBRAS, Rio de Janeiro (Brazil). Centro de Pesquisas). 1986. 8p. (In Portuguese). (CONF-861048—2). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702761.

From 3. Brazilian petroleum congress; Rio de Janeiro, Brazil (5 Oct 1986).

The carbon isotopic composition of natural gases to determine the origin and gaseous hydrocarbon migration of Brazilian sedimentar basins is analysed. The carbon isotopic ratio of methane from natural gases depends on the process of gas formation and stage of organic matter maturation. In the geochemical surface exploration the biogenic gases are differentiated from thermogenic gases, because the last one is isotopically heavier. As the isotopic composition of methane has not changed during migration, the migrated gases from deeper and more mature source rocks are identified by its relative /sup 13/C enrichment. The methane was separated from chromatography and and the isotopic analysis was done with mass spectrometer. (M.C.K.).

41431 **(INIS-BR—664) Thermoluminescence dating of coastal sandy deposits in Rio Grande do Sul, Brazil. First results and implications.** Poupeau, G.; Rivera, A.; Souza, J.H.; Soliani Junior, E.; Vasconcellos, M.B.A. (Sociedade Brasileira de Geologia, Sao Paulo). 1985. 1p. (In Portuguese). (CONF-8510375—6-Summ.). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702772.

From 2. geology South Brazilian symposium; Florianopolis, Brazil (1 Oct 1985).

Published in summary form only.

41432 **(INIS-BR—671) Reinforcing of Al_2O_3 with ZrO_2.** Moreira, N.S.; Pegolo, M.E.; Souza, D.P.F.; Casarini, J.R. (Centro de Tecnologia Educacional para Engenharia, Sao Paulo (Brazil)). 1985. 1p. (In Portuguese). (CONF-8512129—3-Summ.). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702779.

From 4. congress of scientific and technological engineering; Sao Carlos, Brazil (1 Dec 1985).

Published in sumamary form only.

41433 **(INIS-mf—10905) Separation of thulium, ytterbium and lutetium from uranium.** Lopez, G.H. (Universidad Autonoma del Estado de Mexico, Toluca. Escuela de Ciencias Quimicas). 1987. 56p. (In Spanish). NTIS (US Sales Only), PC A04/MF A01. File Number DE87702595.

The behaviour at different temperatures, shaking times and hydrochloric acid concentrations on the solvent extraction system UO_2^{2+} - (Tm^{3+}, Yb^{3+}, Lu^{3+}) - H_2O - HCl - TBP was studied. Quantitative determinations of the elements were performed by visible spectrophotometry and X-ray fluorescence. The uranyl ion was efficiently extracted by TBP from an aqueous hydrochloric acid solution (4-7M) shaken during 10 minutes at room temperature. On these conditions the separation factors for uranium from thulium and ytterbium were found to be 3000 and from lutetium 140.

41434 **(LA-UR—87-2293) A study of in-line plutonium isotopic analysis for gaseous plutonium hexafluoride.** Li, T.K. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 6p. (CONF-870713—34). NTIS, PC A02. File Number DE87013145.

From 28. INMM annual meeting on safeguards: a mature technology; Newport Beach, CA, USA (12 Jul 1987).

In-line plutonium isotopic analysis of gaseous plutonium hexafluoride (PuF_6) is very important for process control and special nuclear material accountability in any plutonium-isotope-separation process that requires a gaseous phase. Although much effort had been devoted to analyze arbitrary plutonium samples, no isotopic analysis had been done on gaseous PuF_6 samples. We have initiated a study on the use of a high-resolution, gamma-ray spectroscopy technique to analyze gaseous plutonium hexafluoride. For the first time, PuF_6 gas samples with pressures varying from 0.15 to 31 torr, which were directly fed into a gas cell from a process flow loop, were measured. The isotopic results of these measurements agree very well with those of mass spectrometry measurements of solid PuF_4. The precision of a 10-min measurement of a 10-torr reactor-grade PuF_6 is 1.5% for ^{238}Pu, 0.22% for ^{239}Pu, 0.87% for ^{240}Pu, and 17.5% for ^{241}Pu.

41435 **(MINTEK-M—297) The interference of zirconium in atomic-emission spectroscopy using inductively coupled plasma.** Wright, P.J. (Council for Mineral Technology, Randburg (South Africa)). 5 Mar 1987. 12p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87900931.

The spectral interference of zirconium on the various channels of the 5 kW ICP-AES system, consisting of a Radyne R50P generator and a Hilger Analytical Polyvac E1000 spectrometer, was investigated. Zirconium is introduced into the sample solutions during the sodium peroxide fusion of solid samples in zirconium crucibles and, after leaching, the solutions contain zirconium in concentrations ranging from 100 to 300 mg/1. The aspiration of synthetically prepared zirconium solutions showed some evidence of interference on nine channels, i.e. those of silver, chromium, copper, iridium, niobium, palladium, tin, titanium, and vanadium. However, with the exception of the silver channel, the interference was negligible. Consequently, only the effect of zirconium interference on the determination of silver was investigated in detail. The effects of the flowrate of intermediate gas, the flowrate of aerosol gas, the height of the observation zone, power variations, the solution feed rate, and different profile settings were also studied. Under a set of compromise optimum plasma-operating conditions, silver can be determined successfully after the results have been corrected by the use of a valid zirconium-correction graph.

41436 **(UCID—21122) The potentiometric titration of fluoride using pH electrodes.** Selig, W.S. (Lawrence Livermore National Lab., CA (USA)). Jul 1987. Contract W-7405-ENG-48. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013575.

Sodium fluoride solutions with an initial pH of 4.46 yielded poorly defined endpoint breaks with a pH electrode system and Ce(III) or La(III) as titrants. At this initial pH, however, the fluoride ISE yielded acceptable S-shaped titration curves. At an initial pH of 6.30, both electrode systems and titrant combinations yielded acceptable endpoint breaks and titration curves. While a partially nonaqueous medium (50% methanol) enhanced the steepness of the endpoint breaks, the standard deviation also increased. This was possibly caused by evaporation of some of the solvent. We therefore do not see the necessity for, nor recommend a partially nonaqueous medium. There is no advantage in using Ce(III) rather than La(III) as titrant. Increasing the initial pH from 4.46 to 6.3 decreased the mean normality of the titrant (or increased the titration volume) for both electrode systems and titrants. We therefore recommend that the sodium fluoride standard solutions be adjusted to the same pH as the samples to be determined. For the most accurate results, the standardization should be done with a good approximation of the salt content of the unknown solution.

41437 **(UCRL—96016-Rev.1) MGA2 [Multiple Group Analysis]: A one-detector code for rapid high-precision plutonium isotopic measurements.** Gunnink, R. (Lawrence Livermore National Lab., CA (USA)). Jul 1987. Contract W-7405-ENG-48. 8p. (CONF-870713—33-Rev.1). NTIS, PC A02. File Number DE87012627.

From 28. INMM annual meeting on safeguards: a mature technology; Newport Beach, CA, USA (12 Jul 1987).

The MGA (Multiple Group Analysis) code which we developed several years ago required two detectors when analyzing high ^{241}Pu content samples. The isotopic information, which was obtained from the 300-keV regions, can now be obtained equally well from the low-energy region (50 to 208 keV). This breakthrough was achieved by developing a unique and highly accurate method for delineating the overall "intrinsic" efficiency curve, including the plutonium K-shell absorption edge discontinuity. Consequently, the intense 129- and 148-keV peak intensities can now be used reliably in place of the peaks in the 300-keV regions to determine the relative abundances of ^{239}Pu and ^{241}Pu. The 203/208- and 148/152-keV pairs, and all of the intense 94- to 104-keV peaks, are included in the analysis to provide accurate data for the other isotopes of interest.

41438 **Stray light rejection in fiber-optic probes.** Skogerboe, K.J.; Yeung, E.S. (Iowa State Univ., Ames). *Analytical Chemistry;* **59**: No. 14, 1812-1815(15 Jul 1987). Contract W-7405-ENG-82.

Stray light is one of the major limitations in fiber-optic probes toward achieving better accuracy and higher sensitivity. Natural reflection off surfaces of the optical components can be reduced by using an index-matching fluid. The residual stray light can be further suppressed by high-frequency modulation and phase discrimination, since light returning from the fiber is temporally separated from the incident radiation. By use of a polished frit to allow longitudinal flow, a cell with 37-nL volume and 3-mm optical path can be constructed to couple with a single 100-μm-diameter optical fiber. Improved performance for absorption measurements is demonstrated for dyes in a flow-injection mode.

41439 **Comparison of rule-building expert systems with pattern recognition for the classification of analytical data.** Derde, M.P.; Buydens, L.; Guns, C.; Massart, D.L.; Hopke, P.K. (Vrije Universiteit Brussel, Belgium). *Analytical Chemistry;* **59**: No. 14, 1868-1871(15 Jul 1987). Contract AC02-80EV10403.

Two expert systems of the rule-building type, TIMM and EX-TRAN, are compared with pattern recognition methods for the classification of olive oils of different origins. Both expert systems are more user-friendly than the pattern recognition programs and TIMM yields slightly better results than nearest neighbors classifiers and linear discriminant analysis.

41440 **Resonance Raman analysis of fluorescent compounds using micellar solutions and ultraviolet laser excitation.** Spino, L.A.; Armstrong, D.W.; Alak, A.M.; Vo-Dinh, T. (Department of Chemistry and Biochemistry, Texas Tech University, Lubbock, Texas 79409 (L.A.S., D.W.A.) and Health and Safety Research Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831 (A.M.A., T.V.-D.)). *Applied Spectroscopy;* **41**: No. 5, 771-773(Jul 1987).

Micelles composed of specifically functionalized surfactants can be used to great advantage in resonance Raman spectroscopy. In addition to circumventing the problem of luminescence background, micelles allow the use of aqueous solvents which stabilize labile species and improve the signal-to-noise ratio. The first examples of micelle-mediated resonance Raman analysis of fluorescent compounds using ultraviolet excitation are given.

41441 **Near-surface analysis and depth profiling by FT-IR photoacoustic spectroscopy.** Yang, C.Q.; Bresee, R.R.; Fateley, W.G. (Department of Chemistry (C.Q.Y., W.G.F.) and Department of Clothing, Textiles Design (R.R.B.), Kansas State University, Manhattan, Kanass 66506). *Applied Spectroscopy;* **41**: No. 5, 889-896(Jul 1987).

Fourier transform photoacoustic spectroscopy (FT-IR/PAS) has proven to be a powerful technique for the near-surface characterization of solid materials. The effective sampling depth of FT-IR/PAS can be varied by using different interferometer mirror velocities, so that nondestructive depth profiling can be performed. In this research, sized cotton yarns, treated glass fibers, chemically modified poly(ethylene terephthalate) fibers and a naturally weathered poly(vinyl chloride) composite were investigated with the use of FT-IR/PAS at different mirror velocities. Penetration of the chemical additives in these materials was studied. It was demonstrated that FT-IR/PAS has the ability to investigate the changes in chemical nature within the detectable surface layers of solid samples.

41442 **Effects of pressure on retention in supercritical fluid chromatography.** Yonker, C.R.; Gale, R.W.; Smith, R.D. (Pacific Northwest Lab., Richland, WA). *Journal of Physical Chemistry;* **91**: No. 12, 3333-3336(4 Jun 1987). Contract AC06-76RL01830.

A simple thermodynamic relationship is described relating solute retention, pressure, and density for supercritical fluid chromatography (SFC). Solute retention in SFC has been predicted based upon the partial molar volume of the solute in the mobile phase and the polymeric stationary phase at infinite dilution. Calculated chromatographic retention for naphthalene and biphenyl has been compared to experimental data for capillary SFC. Predictions of the thermodynamic model accurately fit the retention data, leading to further insight into the retention mechanism in SFC.

41443 **2,6-diacetylpyridine bis(arylhydrazone) derivatives as analytical reagents for uranium.** Bonilla-Alvarez, M.; Palmieri, M.; Davis, D.; Fritz, J.S. (Ames Lab., IA, USA; Iowa State Univ. of Science and Technology, Ames, USA. Dept. of Chemistry). *Talanta;* **34**: No. 5, 473-477(May 1987).

The analytical properties of two compounds from a class of new complexing reagents for uranium have been investigated. The compounds, diacetylpyridine bis(furoylhydrazone) (H_2dapf) and diacetylpyridine bis(pyridylhydrazone) (H_2dapp), were synthesized and the extraction, resin sorption, and colorimetric properties of their metal complexes examined. The uranium-H_2 dapf complex forms in solutions at pH >= 3 and can be used to determine uranium colorimetrically. The system obeys the Lambert-Beer law between 0.72 and 10.8 ppm uranium with a molar absorptivity of 1.5 x 10^4 $l.mole^{-1}$, cm^{-1} at 400 nm and 3.5 x 10^4 $l.mole^{-1}$, cm^{-1} at 350 nm between pH 3 and 8. Interferences are masked with EDTA.

41444 **Synchronous fluorescence measurement of BaP metabolites in human and animal urine.** Uziel, M.; Ward, R.J.; Vo-Dinh, T. (Oak Ridge National Lab., TN). *Analytical Letters;* **20**: No. 5, 761-776(May 1987). Contract AC05-84OR21400.

Injection of Benzo(a)pyrene into rats results in urinary excretion of fluorescent metabolites of BaP. The synchronous fluorescence (SF) technique can detect picogram quantities of fluorescent compounds such as 7,8,9,10-tetrahydro-tetrahydroxybenzo(a)pyrene (BPT). BPT was used as a model compound to show that SF can detect 0.1μM of polynuclear aromatic compounds (PNA) or PNA metabolites in urine by simple dilution. The relatively high concentration limit is due to the need to dilute the urine 100 fold before the characteristic pyrenyl spectrum is observed. The upper limit of direct quantification of BPT without dilution of whole urine is 5 μM because of urine quenching effects. A 100-fold dilution of urine, containing added BPT, restores normal fluorescence and SF spectra. The 0.1 μM detection limit is lower then the observed amounts of individual PNA in nonexposed, nonsmoking humans. This approach may provide a simple, noninvasive tool for monitoring human exposure to fluorescent toxic substances.

41445 **Analysis of oxygen on and in beryllium using 2 MeV helium ions.** Musket, R.G. (Lawrence Livermore National Lab., CA). *Nuclear Instruments and Methods in Physics Research, Section B: Beam Interactions with Materials and Atoms;* **24/25**: No. 2, 698-700(Apr 1987). (CONF-861114—).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Also published as report UCRL—94819; CONF-861114—4-12.

Analysis of oxygen on beryllium can be routinely performed using helium-ion backscattering (RBS). However, determination of the bulk oxygen concentration by this technique is limited to about 350 atomic parts per million (appm). We have performed simultaneous RBS and particle-induced X-ray emission (PIXE) measurements to improve the detection limit for bulk oxygen. The RBS measurements allowed determination of the surface oxygen before and after in situ sputter cleaning by argon ions in an ultra-high-vacuum system. PIXE measurements of specimens with surfaces maintained clean by sputtering permitted assessment of the concentration of oxygen in the bulk. For our geometry and detector sensitivities, 90% of the oxygen X-ray signal originated in the first 2.1 μm of the beryllium and a detection limit of 10 appm was found.

41446 **Use of a high repetition rate neutron generator for in vivo body composition measurements via neutron inelastic scattering.** Kehayias, J.J.; Ellis, K.J.; Cohn, S.H.; Weinlein, J.H. (Brookhaven National Lab., Upton, NY; Sandia National Labs., Albuquerque, NM). *Nuclear Instruments and Methods in Physics Research, Section B: Beam Interactions with Materials and Atoms;* **24/25**: No. 2, 1006-1009(Apr 1987). (CONF-861114—).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

A small D-T neutron generator with a high pulse rate is used for the in vivo measurement of body carbon, oxygen and hydrogen. The core of the neutron generator is a 13 cm-long Zetatron tube pulsed at a rate of 10 kHz delivering 10^3-10^4 neutrons per pulse. A target-current feedback system regulates the source of the accelerator to assure constant neutron output. Carbon is measured by detecting the 4.44 MeV γ-rays from inelastic scattering. The short half-life of the 4.44 MeV state of carbon requires detection of the γ-rays during the 10 μs neutron pulse. Generators with low pulsing rate were found inappropriate for carbon measurements because of their low duty-cycle (high neutron output during the pulse). In vivo measurements were performed with normal volunteers using a scanning bed facility for a dose less than 25 mrem. This technique offers medical as well as general bulk analysis applications.

41447 **Applications of Resonance Ionization Mass Spectrometry in analytical spectroscopy.** Nogar, N.S.; Apel, E.C.; Miller, C.M.; Estler, R.C. (Los Alamos National Lab., Los Alamos, NM 87545). pp TuB6.1-TuB6.4 of Topical meeting on laser applications to chemical analysis (Technical Digest). Washington, DC; Optical Society of America (1987). (CONF-870119—).

From Topical meeting on laser applications to chemical analysis; Lake Tahoe, NV, USA (26 Jan 1987).

RIMS is a powerful tool for elemental and isotopic analysis. This multistep laser photoionization process, when coupled with conventional mass analysis, can provide exceptional performance in detectivity, dynamic range, and discrimination against interfering species. These properties can be used to great advantage both in the analysis of conventional analytical materials and in the interrogation of interfacial phenomenae. In this report the authors will discuss the use of laser desorption/ablation in combination with RIMS analysis. The motivations for this work are threefold. First, the authors desire to improve the effective duty cycle, relative to continuous sample evaporation, for the analysis of conventional analytical samples. Second, the method will allow the direct analysis of materials without extensive sample preparation. And third, the authors wish to study the mechanism of laser-material interactions, particularly optical damage, and characterize the desorption/ablation damage process.

41448 **Fourth symposium on separation science and technology for energy applications.** Bell, J.T.; Watson, J.S. (eds.). New York, NY; Marcel Dekker, Inc. (1987). 1206p. (CONF-851011—).

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

The Fourth Symposium on Separation Science and Technology for Energy Applications was held in Knoxville, Tennessee, October 20-24, 1985. This was the fourth of a series of symposia, held biannually, to bring together practitioners of this diverse discipline in order to exchange knowledge both within and among their specialities on topics related to energy production, utilization, and conservation. Sixty papers delivered at the symposium are presented in this issue of the Journal. Some papers were not included because of unavailable manuscripts or because of editorial considerations. The symposium was organized and conducted under the sponsorship of the US Department of Energy, the American Chemical Society, the National Research Council, and Oak Ridge National Laboratory.

41449 **What are dilute solutions?.** Lightfoot, E.N.; Cockrem, M.C.M. *Separation Science and Technology;* **22**: No. 2/3, 165-189(1987). (CONF-851011—).

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

An operational definition of recovery from dilute solutions is proposed. The major characteristic costs of such recovery processes are identified, and promising strategies for improving equipment and process performance are suggested.

41450 **Solvent extraction recovery of byproduct ^{137}Cs and ^{90}Sr from HNO_3 solutions-a technology review and assessment.** Schulz, W.W.; Bray, L.A. (Rockwell Hanford Operations, Richland, WA). *Separation Science and Technology;* **22**: No. 2/3, 191-214(1987). (CONF-851011—).

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

A principal purpose of this paper is to call out what is perceived to be a timely need for increased research to develop im-

proved and new solvent extraction technology for recovery of ^{137}Cs and ^{90}Sr from strong (≧0.5M HNO_3) acid media, technology which can be quickly scaled up to routine plant-scale operation with highly radioactive waste solutions when needed. The present and forseeable future (2020) US inventory of ^{137}Cs and ^{90}Sr is listed; much of this inventory is expected to be available only in strongly acidic nuclear waste solutions. Comparison of available methods - precipitation and ion exchange as well as solvent extraction - for recovering ^{137}Cs and ^{90}Sr from alkaline and acid media demonstrates, as expected, that very limited technology is available for use with strongly acidic solutions. Solvent extraction procedures which employ either macrocyclic polyethers (crown ethers) or dicarbolide, $H^+\{[\pi\text{-}(3)\text{-}1, 2\text{-}B_9C_2H_{11}Cl_2]_2Co\}^-$, to extract ^{137}Cs and ^{90}Sr from ≧0.5M HNO_3 solutions have recently been proposed. But in their present state of development, both the crown ether and dicarbolide extraction processes have several drawbacks and/or unknowns. Thus, the present results should be considered as a springboard and a spur not only to further development and testing of these particular compounds, but also to continue the search for other extractants which offer even greater potential for plant-scale recovery of byproduct cesium and strontium from acidic wastes.

41451 State-of-the-Art discussion on the solvent extraction reagents used for the recovery of copper from dilute sulfuric acid leach solutions. Kordosky, G.A.; Olafson, S.M.; Lewis, R.G.; Deffner, V.L.; House, J.E. (Henkel Corp., Tucson, AZ). *Separation Science and Technology;* **22**: No. 2/3, 215-232(1987). (CONF-851011—).

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

The recovery of copper from dilute sulfuric acid leach solutions has been a commercial reality since 1968 (1), and since then the technology has gained worldwide acceptance. Only one chelating functionality, the hydroxy oxime group, has been used commercially for this task. There are, however, two distinct classes of extractants based on the hydroxy oxime group: the salicylaldoximes, which are very strong copper extractants and the ketoximes, which are moderate copper extractants. A third class of extractants combines a ketoxime with a salicylaldoxime in about a 1/1 mole ratio and results in some surprising advantages. This paper will discuss each reagent class, showing their advantages and disadvantages and will also introduce two new reagents, LIX 84 and LIX 984, showing their behavior with respect to copper extraction, and discussing where they may be used to advantage.

41452 Role of the interface in the kinetics and mechanisms of extraction of nickel by 8-quinolinols. Aprahamian, E.A. Jr.; Freiser, H. (Univ. of Arizona, Tucson). *Separation Science and Technology;* **22**: No. 2/3, 233-242(1987). (CONF-851011—).

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

The measurement of individual rate constants, as well as the quantitative determination of the contribution of the liquid-liquid interface to the overall extraction kinetics in a well known extraction system, nickel extraction by oxine and its high molecular weight analog (KELEX 100), has revealed that a three path extraction mechanism is operative. The results indicate that the interfacial region provides a more conducive reaction medium in comparison to the bulk aqueous phase. The finding of concurrent bulk and interfacial mechanisms not only reveals the complexity that can be involved in this extraction system, but also enables one to design more efficient separation techniques based on these differences in mechanisms.

41453 Differential homotopy continuation method for interlinked solvent extraction cascades. Frantz, R.W.; Van Brunt, V. (Ethyl Corp., Orangeburg, SC). *Separation Science and Technology;* **22**: No. 2/3, 243-267(1987). (CONF-851011—).

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

A robust differential homotopy procedure is developed that is suitable for solving the bordered block tridiagonal systems of nonlinear equations that result from liquid-liquid extraction models. The procedure is capable of readily utilizing newton, fixed-point, and custom homotopy mapping. It is shown to have an efficiency far superior to Kubicek's method and comparable to that of Rheinboldt. Application of the method to liquid-liquid extraction cascade models revealed that the newton homotopy would converge to a solution as rapidly as a simultaneous correction procedure and that use of a custom homotopy resulted in faster convergence.

41454 Dynamic model for radiotracer determination of solute residence time distribution in counter-current, pulse column solvent extraction processes. Gardner, R.P.; Iqbal, M.N.; Verghese, K. (North Carolina State Univ., Raleigh). *Separation Science and Technology;* **22**: No. 2/3, 269-280(1987). (CONF-851011—).

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

A radiotracer method for the measurement of the mass holdup of a solute being processed in a counter-current pulse column using the average residence time distribution is presented and investigated by mathematical modelling. Typical solutions to the model for impulse tracer injections of the solute at the inlet show that while the number and volume of stages have a significant effect on the response of the system, the amount of backmixing has little effect, particularly for small systems. The system response to impulse tracer injections under various conditions was simulated with this model and model parameters were extracted from these simulated results by using a nonlinear least squares method to demonstrate the approach.

41455 Evaluation of packings for use in liquid-liquid extraction columns. Seibert, A.F.; Humphrey, J.L.; Fair, J.R. (Univ. of Texas, Austin). *Separation Science and Technology;* **22**: No. 2/3, 281-314(1987). (CONF-851011—).

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

Experimental investigations of packing performance in extraction service were conducted in a 10.2 cm. diameter column. Both random and structured packing elements were covered in separate studies. Test systems were toluene/acetone/water and n-butanol/succinic acid/water. Measurements were made of dispersed phase holdup and mass transfer rate. A tentative correlation was developed, based on a modification of basic tests using an empty column, involving an effective drop diameter.

41456 Solvent extraction of copper from a silver electrolyte. Bart, H.J.; Marr, R.; Prior, A. (Institute of Chemical Engineering, Graz, Austria). *Separation Science and Technology;* **22**: No. 2/3, 325-334(1987). (CONF-851011—).

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

This paper presents a process for treatment of an $AgNO_3$ electrolyte. Ag/Cu separation is done with conventional solvent extraction (SX). Cathode copper is electrowon in a diaphragm electrolysis cell while silver scrap is simultaneously dissolved anodically. The process proves to be a very effective recycling technique and is now being investigated on a pilot scale.

41457 Secondary cleanup of Idaho chemical processing plant solvent. Mailen, J.C. (Oak Ridge National Lab., TN). *Separation Science and Technology;* **22**: No. 2/3, 335-345(1987). (CONF-851011—).

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

Solvent from the Idaho Chemical Processing Plant (ICPP) (operated by Westinghouse Idaho Nuclear Company, Inc.) has been tested to determine the ability of activated alumina to remove secondary degradation products - those degradation products which are not removed by scrubbing with sodium carbonate.

41458 Potential for the use of hydrochloric acid in fission reactor fuel recycle. Mailen, J.C.; Bell, J.T. (Oak Ridge National Lab., TN). *Separation Science and Technology;* **22**: No. 2/3, 347-360(1987). (CONF-851011—).

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

The chemistry and the effects of the use of hydrochloric acid (HCl) as the aqueous phase in fuel recycle are surveyed. Avail-

able data are sufficient to suggest that the separation of actinides and fission products in an HCl-trialkylamine system can be at least equal to that in the Purex process. Advantages of the HCl system are: simpler operation of the off-gas system, better separation of neptunium from uranium and plutonium, better control of the oxidation states of the dissolved species, and simpler recycle of the acid. A possible advantage is more complete dissolution of the fission products, leaving very little insoluble residue. Disadvantages include: the lack of development of methods for dissolution of oxide fuel in HCl, the sparsity of distribution data, the requirement for processing equipment constructed of tantalum, possible complications in the waste-handling system, and the dissolution of much of the cladding in the case of stainless-steel clad fuel. Systems using HCl are not attractive as replacements for Purex; however, there may be advantages to their use in some special applications.

41459 **Decontamination of nitrate polluted water.** Kreevoy, M.M.; Kotchevar, A.T.; Aften, C.W. (Univ. of Minnesota, Minneapolis). *Separation Science and Technology;* **22**: No. 2/3, 361-372(1987). (CONF-851011—).

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

Nitrate can be extracted from water at any pH below 10 by a water-insoluble quaternary ammonium 2,4,6-trimethylphenate or N-benzyl-4-methylbenzenesulfonamidate dissolved in trioctylphosphate (TOP). Membranes were prepared by taking up TOP solutions of the quaternary ammonium bases in porous polypropylene (Celgard/sup R/-2400). These membranes were used in a modified dialysis cell to transfer NO_3^- from near-neutral water to stripping solutions of pH, 12-14. Specific rate constants, k, in excess of 10^{-4} cm s^{-1} were observed for nitrate removal under a wide variety of loading and stripping conditions. This is sufficient to project a practical device for the decontamination of nitrate-polluted water. When the hydrodynamic resistances in both the feed and the strip are removed by pumping these solutions through static mixers adjacent to the membrane, k is reduced by making the stripping solution less basic or by increasing its nitrate concentration. These observations suggest that the disassembly of the carrier of the NO_3^- and H^+ at the stripping interface is a stepwise process, involving energetically unfavorable, charge-separated species.

41460 **Effect of possible interferences on the extraction of 1-butanol from aqueous solution by the ethyl esters of soybean oil fatty acids.** Compere, A.L.; Googin, J.M.; Griffith, W.L. (Oak Ridge National Lab., TN). *Separation Science and Technology;* **22**: No. 2/3, 373-378(1987). (CONF-851011—). Contract AC05-84OR21400.

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

The methyl, ethyl, propyl and butyl esters of vegetable and tree oils are effective solvent extractants for 1-butanol from aqueous solution. Early applications of this process will probably involve bacterial mixed solvent fermentations of relatively impure waste and low-valued carbohydrates. Two types of materials, salts and solvents, could be expected to affect the extraction of 1-butanol from such industrial fermentation systems. The effect of four salts, three alcohols, and a ketone were evaluated using factorial experiments. Variations in NaCl, Na_2SO_4, Na_2SO_3, and $KHPO_4$ from 0 to 0.15 M on the extraction of 0.1 to 4.1% 1-butanol from aqueous solutions at 25, 40, and 55 C gave small changes in distribution coefficient. Mild in creases occurred with increasing temperature and increasing NaCl, Na_2SO_4, and KH_2PO_4. Mild decreases in 1-butanol extraction occurred with increasing Na_2SO_3. Variations in acetone, ethanol, and 2-propanol concentrations ranging between 0 and 4% w/v at 25, 40 and 55 C gave small changes in distribution coefficient at 1-butanol concentrations ranging between 0.1 and 4.1% w/v had little effect. A slight increase in 1-butanol extraction was observed with increasing 1-pentanol under similar conditions.

41461 **Mass transfer in countercurrent supercritical extraction.** Lahiere, R.J.; Humphrey, J.L.; Fair, J.R. (Univ. of Texas, Austin). *Separation Science and Technology;* **22**: No. 2/3, 379-393(1987). (CONF-851011—).

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

This paper addresses problems and background information associated with the design of sieve-tray extraction colums operating in the supercritical solvent region. An appropriate mass transfer model is selected, and the needs and sources of basic data are reviewed. The model is executed for both conventional and supercritical extraction cases. Comparisons for both cases are made against measured data. It is concluded that stage efficiencies for the supercritical case are superior, largely due to favorable transport properties.

41462 **Reactor analysis of metal ion extraction in liquid dispersions.** Mukkavilli, S.; Lee, C.K.; Hahn, I.; Tavlarides, L.L. (Syracuse Univ., NY). *Separation Science and Technology;* **22**: No. 2/3, 395-415(1987). (CONF-851011—). Contract AC02-82ER13002.

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

A comprehensive research program is undertaken to predict the effects of mixing on the extraction efficiency for $Co(NO_3)_2$-Di-2-ethylhexyl phosphoric acid in toluene system in mechanically agitated dispersed phase reactors. The experimental and theoretical studies on this complex hydrometallurgical extraction system have yielded the following results. A) A two phase organic and aqueous equilibrium model, which accounts for the aqueous phase equilibria, is developed to predict the distribution of cobalt. The equilibrium model is based on cobalt ion complexation with the DEPHA dimer as suggested by Komasawa et al. The aqueous phase activities are represented by the Davies Model. B) Physical mass transfer and chemical extraction experiments conducted in a stirred transfer reactor show that the reaction occurs in the aqueous film. A two film diffusion-reaction model is developed to accurately predict the observed fluxes over the experimental range. The composition and temperature ranges for the equilibrium and kinetic experiments are, respectively: a) pH, 3-5; [Co]/sub T/, 0.001 to 0.1 M; $[DEHPA]_2$, 0.1 to 1.0 M; T, 25-50°C, and b) pH, 3-5; [Co]/sub T/, 0.001 to 0.1 M; $[DEHPA]_2$, 0.01 to 0.5 M; T = 25°C. C) A previously developed Monte Carlo Simulation procedure is employed with the above equilibrium and kinetic models to predict the effect of droplet mixing on extraction efficiency for various process variables. The above experimental and theoretical procedure can be applied to the study of other two phase dispersion systems and can be extended to multiple reactors.

41463 **Alkane-insoluble trialkylammonium double salts involving the dodecamolybdophosphate anion. II. Effect of amine structure on third-phase formation.** Moyer, B.A.; McSowell, W.J. (Oak Ridge National Lab., TN). *Separation Science and Technology;* **22**: No. 2/3, 417-445(1987). (CONF-851011—). Contract AC05-84OR21400.

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

In this paper, a rational basis is presented for the control of molybdenum third phase formation in tertiary amine extraction through appropriate selection of amine structure. The studies have been founded on the observation that third-phase formation in the amine-extraction of molybdenum is mainly caused by the formation of heteropolymolybdates, especially the dodecamolybdophosphate anion $PMo_{12}O_{40}^{3-}$ (DMP). Eight triaklylamine structures with straight and methyl-branched, 8- to 13-carbon chains have been examined with regard to the type of third phase formed and the maximum molarity of the dissolved salt $(R_3NH)_3$[DMP] that can be tolerated in the solvent before precipitation occurs (i.e., the DMP tolerance, a type of solubility measurement). In the experiments, a standard solvent consisting of 0.05 M tertiary amine (primarily as the trialkylammonium sulfate salt) and 0.15 M n-dodecanol in n-nonane was used. For all of the amines tested, third-phase formation first involved co-extraction of Mo(VI) and phosphate from 0.1 M H_2SO_4 giving the dissolved salt $(R_3NH)_3$[DMP] over extended equilibration times (days to weeks).

41464 **Mass transport from single droplets in imposed electric fields.** Wham, R.M.; Byers, C.H. (Oak Ridge National Lab., TN). *Separation Science and Technology;* **22**: No. 2/3, 447-466(1987). (CONF-851011—). Contract AC05-84OR21400.

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

The influence of electric charge phenomena on mass transfer in systems involving droplets in a continuous medium is of increasing importance. The enhanced transport behavior of droplets in imposed fields on mass transfer and the influence of naturally occurring charges on droplets, particularly in the atmosphere, are both subjects of current interest. The objective of this study is to elucidate the hydrodynamic and mass transfer effect of imposed fields on charged single droplets. Investigations of both static and pulsed electric fields are reported. The experimental approach is based on the suspension of single droplets in a precisely machined expanding channel. A stationary, saturated water droplet is fluidized by the upflow of 2-ethylhexanol. This arrangement allows precise photographic monitoring of droplet size and shape as well as the hydrodynamics of both phases in the region of the interface.

41465 **Structural aspects of hydrometallurgical solvent extraction.** O'Quinn, L.N.; Van Brunt, V. (Univ. of South Carolina, Columbia). *Separation Science and Technology;* **22**: No. 2/3, 467-485(1987). (CONF-851011—).

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

Hydrometallurgical liquid extraction systems have previously been modeled using sum-of-the-rates (SR) forms, a noted exception is the procedure outlined by Chapman for a single cascade with two hypothetical solutes. In this paper Chapman's simultaneous convergence (SC) procedure is extended to use in a real multicascade, multisolute system with competing mass action equilibrium expressions. Methods for inclusion of nonstandard specifications directly into the convergence procedure are examined. A finite region of convergence from initial estimates of nonstandard specifications is developed. It was found that for the base extraction case (iteration only on concentration variables for both phases) that convergence was rapid, no special scaling or initial iteration procedures were required. The inclusion of the specifications into the problem was found to: 1) reduce the region of convergence; and 2) require damped newton iterates for convergence.

41466 **Selective solvation extraction of gold from alkaline cyanide solution by alkyl phosphorus esters.** Miller, J.D.; Wan, R.Y.; Mooiman, M.B.; Sibrell, P.L. (Univ. of Utah, Salt Lake City). *Separation Science and Technology;* **22**: No. 2/3, 487-502(1987). (CONF-851011—).

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

Research efforts have shown that solvation extraction of gold from alkaline cyanide solution is possible by alkyl phosphorus esters. Both tributyl phosphate (TBP) and dibutyl butyl phosphonate (DBBP) appear to be effective extractants for gold and exhibit high loading capacities exceeding 30 gpl. Selective solvation extraction of gold from alkaline cyanide solution can be achieved with selectivity factors relative to other cyanoanions as high as 1000 under certain circumstances. Variables influencing the selectivity such as ionic strength, temperature, and extractant structure, are discussed in terms of the extraction chemistry, which seems to involve the solvation of a M^+ dot, dot, dot $Au(CN)_2^-$ ion pair.

41467 **Use of electronic worksheets for calculation of stagewise solvent extraction processes.** Leonard, R.A. (Argonne National Lab., IL). *Separation Science and Technology;* **22**: No. 2/3, 535-556(1987). (CONF-851011—). Contract W-31-109-ENG-38.

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

The electronic worksheet, a powerful new tool for engineering analysis, is used to calculate flowsheets for stagewise solvent extraction processes. The algorithms presented give the component concentration of each stage at steady-state conditions and an estimate of the time to reach steady state. Any number of inlet and exit streams can be included and a different distribution ratio can be specified for each stage. The procedure is illustrated using a nuclear waste flowsheet. Although this paper deals with stagewise solvent extraction, it shows the utility of the electronic worksheet for many types of scientific and engineering calculations.

41468 **Solvent extraction, membranes, and ion exchange in hydrometallurgical dilute metals separation.** Tavlarides, L.L.; Bae, J.H.; Lee, C.K. (Syracuse Univ., NY). *Separation Science and Technology;* **22**: No. 2/3, 581-617(1987). (CONF-851011—). Contract AC02-82ER13002.

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

The separation methods which are used in the hydro-metallurgical field are reviewed and compared. Some processes in solvent extraction in use for recovery of crucial metals which are important to the US defense and economy are presented. Various commercial extractants are reviewed and categorized. Other methods such as liquid membranes and ions exchange resins used for dilute metal ions separation are summarized. These methods are compared with solvent extraction. Problems to overcome in the future development of these separation methods are also identified and discussed in this paper.

41469 **Microporous membrane solvent extraction.** Prasad, R.; Sirkar, K.K. (Stevens Institute of Technology, Hoboken, NJ). *Separation Science and Technology;* **22**: No. 2/3, 619-640(1987). (CONF-851011—).

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

The versatility of the phenomenon of dispersion-free solvent extraction through immobilized aqueous-organic interface in a microporous hydrophobic membrane is demonstrated here. This technique has been used here for an organic-organic interface to extract aromatics from a hydrocarbon feedstock by a polar organic solvent. The phenomenon has been studied further with microporous hydrophilic and composite hydrophobic-hydrophilic membranes. Operational modes and the influence of the membrane and boundary layer resistances for various solvent-solute-membrane systems have been studied for a CELGARD (hydrophobic) and a CUPROPHAN (hydrophilic) membrane. Limited performance data for microporous hydrophobic CELGARD hollow fibers (X-20) are also presented.

41470 **Double liquid membrane system for the removal of actinides and lanthanides from acidic nuclear wastes.** Chiarizia, R.; Danesi, P.R. (Argonne National Lab., IL). *Separation Science and Technology;* **22**: No. 2/3, 641-659(1987). (CONF-851011—). Contract W-31-109-ENG-38.

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

Supported liquid membranes (SLM), consisting of an organic solution of n-octyl(phenyl)-N,N-diisobutylcarbamoylmethylphosphine oxide (CMPO) and tributyl-phosphate (TBP) in decalin are able to perform selective separation and concentration of actinide and lanthanide ions from aqueous nitrate feed solutions and synthetic nuclear wastes. In the membrane process a possible strip solution is a mixture of formic acid and hydroxylammonium formate (HAF). The effectiveness of this strip solution is reduced and eventually nullified by the simultaneous transfer through the SLM of HNO_3 which accumulates in the strip solution. A possible way to overcome this drawback is to make use of a second SLM consisting of a primary amine which is able to extract only HNO_3 from the strip solution. In this work the results obtained by experimentally studying the membrane system: synthetic nuclear waste/CMPO-TBP membrane/HCOOH-HAF strip solution/primary amine membrane/NaOH solution, are reported. They show that the use of a second liquid membrane is effective in controlling the HNO_3 concentration in the strip solution, thus allowing the actinide and lanthanide ions removal from the feed solution to proceed to completion.

41471 **Pilot-scale evaluation of supported liquid membrane extraction.** Dworzak, W.R.; Naser, A.J. (Rockwell Hanford Operations, Richland, WA). *Separation Science and Technology;* **22**: No. 2/3, 677-689(1987). (CONF-851011—).

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

An evaluation of a solvent extraction system employing supported liquid membranes has recently been completed by Rockwell Hanford Operations. The focus was on a pilot-scale, tube and shell arrangement configured for continuous operation. The tube bundle consisted of 333 polypropylene microporous fibers with a total sur-

face of 3.6 m^2. Results are reported for the evaluation of operating parameters such as flow rates and corresponding aqueous pressure differences, solvent impregnation techniques, and test system durability. Chemical and physical test results, including permeability data, are also reported for the systems nitrate ion/nitric acid/tertiary amine and (nonradioactive) Group IA-IIA metal/nitric acid/phosphoric acid extractant.

41472 **Separation and recovery of metals from dilute solids and aqueous phases.** Wadsworth, M.E. (Univ. of Utah, Salt Lake City). *Separation Science and Technology;* **22**: No. 2/3, 711-730(1987). (CONF-851011—).

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

Present practice for the extraction of metals from low grade dilute ore sources and the recovery of metal values from dilute solutions is reviewed. Special problems associated with extraction from both solid and aqueous phases for copper, gold and silver recovery are considered. Emphasis is directed toward the application of in situ solution mining technology for recovery of metal values in the future.

41473 **Overview of membrane separations.** Noble, R.D. (National Bureau of Standards, Boulder, CO). *Separation Science and Technology;* **22**: No. 2/3, 731-743(1987). (CONF-851011—).

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

The field of membrane separations is discussed. The major membrane types and applications are outlined. The outlook with respect to research activities and commercial applications is surveyed. The advantages and disadvantages of this separation process are discussed. Certain applications where membranes may save energy and improve productivity are also discussed.

41474 **Concentration polarization effects in the use of micellar-enhanced ultrafiltration to remove dissolved organic pollutants from wastewater.** Dunn, R.O. Jr.; Scamehorn, J.F.; Christian, S.D. (Univ. of Oklahoma, Norman). *Separation Science and Technology;* **22**: No. 2/3, 763-789(1987). (CONF-851011—). Contract AS05-84ER13175.

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

Micellar-enhanced ultrafiltration (MEUF) is used to remove 4-tert-butylphenol (TBP) from aqueous solution, a separation for which traditional ultrafiltration is ineffective. A micelle-forming surfactant is added to the solution. The micelles solubilize a high fraction of the TBP. The stream is then forced through an ultrafilter. Overall rejection of TBP was greater than 99% under all conditions studied and did not decrease with increasing pressure drop. Micelles were completely rejected by membranes with pore size 10,000 Dalton MWCD and below. Concentration polarization affects MEUF fluxes under conditions of interest. Gel polarization theory does not completely explain MEUF flux behavior. Selection of optimum operating parameters in MEUF application are discussed.

41475 **Removal of acetic acid from wastewater with liquid surfactant membranes: an external boundary layer and membrane diffusion controlled model.** Yan, N.X.; Huang, S.A.; Shi, Y.J. (East China Institute of Chemical Technology, Shanghai). *Separation Science and Technology;* **22**: No. 2/3, 801-818(1987). (CONF-851011—).

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

A new diffusion controlled mass transfer model has been established for uniform emulsion globules without redispersion and internal circulation. Both the external boundary layer and the membrane resistance to mass transfer are taken into account and the perturbation solutions have been obtained. Experimental data on the batch extraction of acetic acid from wastewater are in good agreement with the model predictions. Usually, the zero-order, or pseudo-steady state solution alone can give an adequate description of the process. The swell of emulsion can be classified into two types - permeation and entrainment. The swelling rate by permeation of water increases with increasing the concentration of surfactant and internal reagent. Repeated redispersion and vigorous stirring promote the swell due to the entrainment. The swelling mechanism of the entrainment has been discussed.

41476 **Study of operating condition affecting mass transfer rate in liquid surfactant membrane process.** Ma, X.S.; Shi, Y.J. (East China Institute of Chemical Technology, Shanghai). *Separation Science and Technology;* **22**: No. 2/3, 819-829(1987). (CONF-851011—).

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

The removal of acetic acid from its dilute solution by liquid surfactant membrane (LSM) has been investigated by batch test. Some important factors affecting the mass transfer rate, such as surfactant and its content, stirring speed, ratio of reagents, treating ratio and volume ratio of membrane phase to internal phase, have been studied. The breakage and the swelling of the emulsion have also been investigated. The transport mechanism of HA/sub c/ across the membrane in the system is referred to as I-II facilitated transport mechanism.

41477 **Supported extractant membranes for americium and plutonium recovery.** Muscatello, A.C.; Navratil, J.D.; Killion, M.E.; Price, M.Y. (Rockwell International, Golden, CO). *Separation Science and Technology;* **22**: No. 2/3, 843-853(1987). (CONF-851011—). Contract AC04-76DP03533.

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

Solid supported liquid membranes(SLM) are useful in transferring and concentrating americium and plutonium from nitrate solutions. Specifically, DHDECMP(dihexyl-N,N-diethylcarbamoylmethylphosphonate) supported on Accurel or Celgard polypropylene hollow fibers assembled in modular form transfers >95% of the americium and >70% of the plutonium from high nitrate (6.9 M), low acid (0.1 M) feeds into 0.25 M oxalic acid stripping solution. Membranes supporting TBP (tri-n-butylphosphate) also transfer these metal ions. Maximum permeabilities were observed to be 1 x 10^{-3} cm sec^{-1}, similar to the values for other systems. The feed:strip volume ratio shows an inverse relationship to the fraction of metal ion transferred. Cation exchangers may be used to concentrate americium from the strip solution.

41478 **Low temperature distillation through hydrophobic membranes.** Gostoli, C.; Sarti, G.C.; Matulli, S. (Universita di Bologna, Italy). *Separation Science and Technology;* **22**: No. 2/3, 855-872(1987). (CONF-851011—).

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

The use of hydrophobic porous membranes makes it possible to maintain liquid-vapor interfaces localized at a membrane surface. Based on that, thermally driven separation processes were obtained through the membrane and thoroughly analyzed both experimentally and theoretically. Two experimental conditions were used: i) the porous membrane is in direct contact with two liquid aqueous phases on both sides and the vapor phase is trapped inside the pores (capillary distillation); ii) on one side of the porous membrane there is a warm aqueous solution, while an additional gaseous gap is maintained on the opposite side of the porous membrane; the vaporizing component diffuses through the entire gas phase and condenses at a cold surface confining the gaseous gap (cold wall distillation). The mathematical model, describing both the separation rate and the energy flux is presented and compared with the experimental results. The influence of the gas membrane thickness is also discussed.

41479 **Temperature sensitive gels as size selective absorbants.** Freitas, R.F.S.; Cussler, E.L. (Univ. of Minnesota, Minneapolis). *Separation Science and Technology;* **22**: No. 2/3, 911-919(1987). (CONF-851011—).

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

The authors used crosslinked polymer gels as extraction solvents for aqueous solutions. The gels swell to many times their dry weight by absorbing water and low molecular weight solutes, but excluding proteins and other high molecular weight solutes. The swollen gel is removed by filtration. When it is slightly warmed, it collapses, releasing most of the absorbed material. This sudden

change of swelling with temperature occurs because the gel is near a critical point. After the gel is separated from the desorbed water by filtration, it is cooled and then can be reused.

41480 **Simultaneous absorption of H_2S and Co_2 into aqueous methyldiethanolamine.** Haimour, N.; Bidarian, A.; Sandall, O.C. (Univ. of California, Santa Barbara). *Separation Science and Technology;* **22**: No. 2/3, 921-947(1987). (CONF-851011—).

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

The tertiary amine methyldiethanolamine (MDEA) is finding increasing application as a chemical solvent for selective absorption of hydrogen sulfide from gases containing hydrogen sulfide and carbon dioxide. Gas streams of this type include some natural gases, synthetic gases from coal and heavy oil gasification and tail gases from sulfur plants. Selectivity for H_2S is needed either to enrich Claus sulfur plant feed in H_2S or to remove only H_2S when CO_2 removal is not necessary of economic. For the absorption of hydrogen sulfide into MDEA, the reaction which occurs can be considered to be instantaneous while carbon dioxide undergoes a second-order reaction with MDEA. In this work, the simultaneous absorption of two gases into a liquid containing a reactant with which both gases react is modelled using the film theory. Physical properties and kinetic rate parameters used in the model have been measured in the laboratory. The model is used to study the effect of process variables on the selectivity of MDEA for H_2S over CO_2. The simultaneous absorption of H_2S and CO_2 gases into aqueous MDEA is studied experimentally using a continuous stirred tank absorber. Experimental absorption rates are compared to predictions based on a multicomponent mass transfer model. The average deviations of the theoretical calculations from the experimental results are 10.2% and 12.9% for CO_2 and H_2S, respectively.

41481 **Electrically stabilized expanded beds for sorption separations.** Watson, J.S.; Byers, C.H.; Reinholt, D.R. (Oak Ridge National Lab., TN). *Separation Science and Technology;* **22**: No. 2/3, 949-961(1987). (CONF-851011—). Contract AC05-84OR21400.

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

Recent studies have shown that when high electric fields are imposed on expanded fluidized beds, motion of the particles can cease. This provides the potential for fixed bed operations with the void fraction sufficiently large that only moderate pressure drops are required, even with small particles. This paper explores the dielectric forces that inhibit particle motion in alternating-current electric fields and the potential and limitations of the concept for adsorption operations. The dielectric constants of the particles and the fluid, the size of the particles, the density and viscosity of the fluid, and the imposed electric field gradient are the variables of most importance to bed stabilization. In adsorption tests, the expanded-stabilized beds perform essentially as well as densely packed fixed beds but with only a fraction of the pressure drop.

41482 **Energy consumption of chemical uranium enrichment.** Miyake, T.; Takeda, K.; Obanawa, H. (Asahi Chemical Industry Co., Ltd., Hyuga, Japan). *Separation Science and Technology;* **22**: No. 2/3, 963-971(1987). (CONF-851011—).

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

A quantitative study of chemical separation energy for enriching uranium-235 by the redox chromatography was conducted. Isotope exchange reactions between U^{4+}-UO_2^{2+} ions in the enrichment column are maintained by the redox reactions. The chemical separation energy is ultimately supplied by hydrogen and oxygen gas for regenerating redox agents. The redox energy for the isotope separation is theoretically predicted as a function of the dynamic enrichment factor observed in the chromatographic development of uranium adsorption band. Thermodynamic treatments of the equilibrium reactions implies and inverse redox reaction which can be enhanced by the chemical potential of the ion-exchange reaction of oxidant. Experimental results showed 30 to 90% recovery of the redox energy by the inverse reaction. These results will devise a simplified redox chromatography process where a number of columns in one module is reduced.

41483 **Carbon molecular sieve membranes. General properties and the permeability of CH_4/H_2 mixture.** Koresh, J.E.; Soffer, A. (Nuclear Research Center, Negev, Israel). *Separation Science and Technology;* **22**: No. 2/3, 973-982(1987). (CONF-851011—).

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

The properties, the advantages and drawbacks of hollow fiber carbon molecular sieving membranes as gas separators are discussed. Some mechanistic aspects are surveyed and permeability of methane-hydrogen mixture through the carbon membrane was studied. The presence of methane which is adsorbable and a poor permeant, does not impair the permeability of hydrogen even at temperatures as low as -80°C. This suggests that, because of the large difference in size of the two molecules, they occupy different positions in the membrane material prior to the jump through a critical constriction.

41484 **Bifuncitonal phosphinic acid resins for the complexation of lanthanides and actinides.** Alexandratos, S.D.; Quillen, D.R.; McDowell, W.J. (Univ. of Tennessee, Knoxville). *Separation Science and Technology;* **22**: No. 2/3, 983-995(1987). (CONF-851011—). Contract AS05-83ER13113.

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

Phosphinic acid ion exchange/redox resins are synthesized by the reaction between polystyrene beads and phosphorus trichloride followed by base hydrolysis. The reaction requires a temperature of 73°C for full functionalization to occur. The effect of lower functionalization temperatures on resin acid capacity was determined and the concomitant effect on ion exchange investigated. The acid capacity was found to vary from 1.68 mequiv/g to 4.79 mequiv/g in the functionalization temperature range studied (15°C to 73°C). The present resin sites loaded with zinc ions is independent of the actual capacity. The extracting ability of the phosphinic acid resin for europium, thorium, uranium, americium, and plutonium was examined as a function of acid concentration from acid nitrate solutions both at varying and constant ionic strength. The phosphinic resins show better extraction for these ions than the sulfonic resins, especially from high acid solution (4M HNO_3) due to the superior coordination ability of the phosphoryl oxygen. They also show a higher selectivity for the ions tested over sodium. For example, under conditions where sulfonic resins absorb 85% of the plutonium in solution, the phosphinic acid resins absorb 99.7%.

41485 **CSA continuous countercurrent ion exchange (CCIX) technology.** Higgins, I.R.; Denton, M.S. (CSA, Inc., Oak Ridge, TN). *Separation Science and Technology;* **22**: No. 2/3, 997-1015(1987). (CONF-851011—).

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

The CSA-CCIX concept started at ORNL in 1951. It has been adapted to a wide variety of applications worldwide, in water and waste water treatment, fertilizers, hydrometallurgy, and general chemical processing. Unique features and how it works are described. Two extreme applications are described in detail. One is for the extraction of trace amounts of uranium from a copper leach, at 37.85m^3/min (10,000 gpm) where very high throughput rates are emphasized. The other is for Acid Retardation, where a strong acid waste is purified and recovered. The feed processing rate here is much lower than the resin rate.

41486 **Purification of aqueous suspensions from colloidal particles by electro-adsorption on porous carbon electrodes.** Hall, D.; Priel, Z.; Oren, Y.; Soffer, A. (Ben-Gurion Univ., Beer-sheva, Israel). *Separation Science and Technology;* **22**: No. 2/3, 1017-1027(1987). (CONF-851011—).

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

The electrically induced adsorption of carboxylated colloidal particles from aqueous suspension on a carbon electrode was studied. Due to high colloid to electrode charge density ratio, adsorption is effected only to a small extent when the electrode potential is varied within the double layer potential range. At extreme potentials where water is involved in Faradaic reactions, colloid adsorption occurs due to pH variations. The process may be attractive for

purification of suspensions from fine particles since no chemicals have to be added in order to induce adsorption or desorption of the colloid.

41487 **Compressibility of particulate structures in relation to thickening, filtration, and expression - a review.** Tiller, F.M.; Yeh, C.S.; Leu, W.F. (Univ. of Houston, TX). *Separation Science and Technology;* **22**: No. 2/3, 1037-1063(1987). (CONF-851011—). Contract AS05-81ER10946.

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

Compressibility of cakes is basic to separation of solids from slurries. Cake compression is caused by collapsing, particulate structures in which particles are forced into existing voids. Stresses causing the collapse arise from unbuoyed weight of solids in thickeners, radial acceleration in centrifuges, frictional pressure drop in filters, and mechanical forces in press belts and membrane actuated filters. Compressibility is a function of particle size and shape and the degree of aggregation. Flow through very compressible cakes produces a highly non-uniform structure with a tight skin of low porosity next to the supporting medium. This skin leads to adverse effects in which increasing filter pressure has little effect on flow rate or average porosity. Similarly increasing the squeezing pressure indefinitely in expression has little effect upon the rate of removal of liquid.

41488 **Stripping organics from metal and mineral surfaces using supercritical fluids.** Tolley, W.K.; Altringer, P.B.; Seidel, D.C. (Dept. of the Interior, Salt Lake City, UT). *Separation Science and Technology;* **22**: No. 2/3, 1087-1101(1987). (CONF-851011—).

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

Superalloy grinding swarf was treated with supercritical CO_2 alone, and with various modifiers. Experiments were conducted in a downflow batch mode at pressures of 0 to 5000 psig, temperatures of 20° to 250°C, and times of 15 to 240 min using up to 25 g of solvent per gram of swarf. Organic dissolution increased with pressure almost linearly to 5000 psig. Temperature affected dissolution slightly at lower pressure, but not significantly at higher pressure. Certain alcohols used as modifiers dramatically improved organic dissolution. The solvent, modifier organics, and solids were easily recovered as separate products.

41489 **Equilibrium and rate data for the extraction of lipids using compressed carbon dioxide.** King, M.B.; Bott, T.R.; Barr, M.J.; Mahmud, R.S.; Sanders, N. (Univ. of Birmingham, England). *Separation Science and Technology;* **22**: No. 2/3, 1103-1120(1987). (CONF-851011—).

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

Equilibrium data are given for the solubilities in compressed CO_2 of the lipid components in freshly ground rape seed and of glycerol trioleate (a typical constituent of rape oil) at pressures up to 200 bar and temperatures 25 to 75C. Continuous flow tests in which a bed of ground rape seed was contacted with a stream of liquid CO_2 at 25C and varied flow conditions are also reported. The results are collated in terms of an empirical mass transfer coefficient. A sharp change took place in the lipid concentration in the extractant stream leaving the bed when about 65% of the available oil had been extracted. This, and changes in the composition of the extract, are discussed, together with the use of this type of data for design purposes.

41490 **Pyrochemical extraction of transition metals from Pacific Ocean deep sea nodules.** von Winbush, S.; Maroni, V.A. (State Univ. of New York, Long Island). *Separation Science and Technology;* **22**: No. 2/3, 1135-1148(1987). (CONF-851011—). Contract W-31-109-ENG-38.

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

Considerable success has been achieved in lixiviation transition metals from Pacific Ocean deep sea nodules. These nodules typically contain ~30 wt% Mn, ~7 wt% Fe, ~1 wt% Ni, ~1 wt% Cu, and ~0.3 wt% Co. Samples of the nodules have been subjected to extraction tests at 450°C using LiCl-KCl eutectic and $MgCl_2$-NaCl-KCl eutectic. The most impressive results came from studies using the Mg, Na, K/Cl eutectic. With this salt, nearly 100% of the Co, Cu, Fe, Mn, and Ni are brought into solution. The dissolution reaction is quite vigorous, with nearly complete extraction occurring in a very short time (minutes) following melting of the eutectic. Quantitative recovery of cobalt is achieved with nodule-to-salt weight ratios as high as 1:3. Electronic absorption spectroscopy (carried out on the molten extract solution at the test temperature) showed that the oxidation state of the dissolved transition metals are Co^{2+}, Cu^{2+}, Fe^{3+}, Mn^{2+}, and Ni^{2+}. At temperatures $\geqq$450°C, the Fe^{3+} and Cu^{2+} distill out of the extract solution at a rapid rate and condense as binary halides or halide complexes. Using a combination of distillation followed by electrochemical reduction of the Co^{2+} and Ni^{2+} in the extract salt, it appears possible to recover a fairly high grade of cobalt metal and nickel metal as well as high grade Cu^{2+}, Fe^{3+}, and Mn^{2+} in the form of a halide salt ($CuCl_2$, $FeCl_3$) or an oxide precipitate (Mn_2O_3).

41491 **Leaching kinetics of platinum and palladium from spent automotive catalysts.** Tyson, D.R.; Bautista, R.G. (Iowa State Univ., Ames). *Separation Science and Technology;* **22**: No. 2/3, 1149-1167(1987). (CONF-851011—).

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

Empirical rate expressions for both platinum and palladium were obtained from mass balances and concentration-time data in a packed bed reactor using different (HCl):(HNO_3) leaching solution concentration ratios. The spent catalysts used in this study (-60 + 70 mesh to -120 + 140 mesh) were analyzed to be 3791 ppm platinum and 1306 ppm palladium. High initial rates for both platinum and palladium were obtained for the early stages of leaching and were followed by rapid decay up to about 110 minutes and 50 minutes respectively. Typical concentrations in the leached solution were about 40 ppm Pt and 20 ppm Pd after about 5 hours for the experimental conditions used. The extent of reaction for platinum was in the 90 percent range while that of the palladium was in the 70 percent range.

41492 **Studies of a liquid anode for plutonium electrorefining.** Bowersox, D.F.; McNeese, J.A.; Christensen, D.C. (Los Alamos National Lab., NM). *Separation Science and Technology;* **22**: No. 2/3, 1183-1197(1987). (CONF-851011—).

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

They are developing a solvent anode as an alternate method for producing plutonium metal of high purity by an electrorefining process. The goals are to produce metal of 99.98% purity with an anode residue containing less than 2% of the plutonium in the feed material. If they are successful, they will design and demonstrate a system utilizing semi-continuous and remotely controlled operations. Establishing a solvent anode method should lead to improved yields and a substantial reduction in the amount of residues generated by the electrorefining process. The new method should be a viable pyrochemical technique for recovering both plutonium and uranium from spent reactor fuel. Initially, the anode consists of a tantalum rod immersed in a pool of liquid cadmium at 740°C. Impure plutonium or a solid anode residue is in contact with the cadmium. As current passes through the anode, plutonium in the cadmium is oxidized and transfers into the molten salt as tripositive plutonium. More plutonium dissolves into the cadmium and the oxidation continues. The tri-positive plutonium is carried through the salt to the cathode, where it is reduced to pure, liquid metal. This metal, which is heavier than the salt, drips from the cathode into an annulus between the anode and cathode compartments and forms a product ring.

41493 **Empirical formulae determination of gas chromatography effluents by microwave induced helium plasmas.** Evans, J.C.; Olsen, K.B.; Sklarew, D.S. (Earth Sciences Dept., Pacific Northwest Lab., Richland, WA 99352). pp 89-90 of Proceedings of the 1896 winter conference on plasma spectrochemistry. Amherst, MA; ICP Information Newsletter (1986). (CONF-860101—). Contract AC06-76RL01830.

From Winter conference on plasma spectrochemistry; Maui, HI, USA (3 Jan 1986).

Pacific Northwest Laboratory has initiated, under U.S. Department of Energy support, a program aimed at developing a methodology for element specific detection of capillary column gas chromatography effluents using a microwave induced helium plasma detector (GC-MIP). In particulate, procedures are under development for empirical formulae determination of compounds containing nitrogen and/or sulfur. This paper presents some preliminary results from the formative stages of this project.

41494 **Analytical applications of lasers.** Piepmeier, E.H. (ed.). New York, NY; John Wiley & Sons (1986). 716p. John Wiley & Sons, 605 Third Ave., New York, NY 10016 $89.95.

From review by Nick S. Nogar, Los Alamos National Lab., in Analytical Chemistry, Vol. 59, No. 11,(1 Jun 1987).

The author has edited and contributed to a monograph containing an interesting array of topics in both traditional and unconventional laser-based analyses. This volume begins with an overview of laser principles and concepts then proceeds with sections on various detection schemes, high-resolution spectroscopy, multiphoton techniques, hyphenated methods, and methods based on the special properties (coherence, brightness, short pulses, etc.) of lasers.

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REFER ALSO TO CITATION(S) 40603, 40604, 40605, 40607, 40608, 40640, 40641, 40644, 40685, 40707, 40708, 40710, 40711, 40713, 40714, 40715, 40816, 41321, 41339, 41372, 41390, 41405, 41484, 41493, 41544, 41637, 41656, 41859

41495 **(AD-A—180422/8/XAB) Multiple-dose study of oral pyridostigmine in swine. Interim report, January 1986-January 1987.** Wade, C.E.; Waring, P.P.; Trail, D.S.; Williams, B.F.; Bonner, G.D. (Letterman Army Inst. of Research, San Francisco, CA (USA)). Mar 1987. 14p. (LAIR—87-67). NTIS, PC A02/MF A01.

The hemodynamic, metabolic, and hormonal responses to pyridostigmine treatment were evaluated in immature swine(20.7 + or - 0.5 kg). Pyridostigmine bromide was administered orally three times per day at 60 mg per dose. Animals receiving treatment (n=12) were compared to a group with no treatment (n=14). After three days of treatment, plasma and erythrocyte cholinesterase activities were reduced by 31% and 47%, respectively. Blood gases, heart rate, and blood pressure were not different. Pyridostigmine tended to increase blood glucose levels and elevated hematocrits 26 to 29%. Treatment with 60 mg of pyridostigmine three times daily for three days reduced acetylcholinesterase activity as desired in man for prophylactic treatment against possible exposure to nerve agents. In swine this degree of inhibition of acetylcholinesterase activity was associated with an index of stress, a slight increase in hematocrit. Swine appear to offer an effective animal model in which to evaluate pyridostigmine treatment.

41496 **(BNL—40026) Electron kinetics in nonpolar liquids-energy and pressure effects.** Holroyd, R. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 17p. (CONF-870781—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012487.

From Conference on the liquid state and its electrical properties; Sintra, Portugal (5 Jul 1987).

The energy of the bottom of the conduction band is one factor influencing electron kinetics. Anions formed by attachment are stabilized in solution and volume changes are manifestations of the free energy associated with polarization by the anions. This volume constriction around anions explains why equilibria shift toward the ions with increasing pressure. At the same time electrostriction around the ion corresponds to a state of low entropy and is the source of the large increase in entropy on electron detachment; an effect which helps shift equlibria reactions back toward the electron.

41497 **(BNL—40037) Progress and trends in superoxide research.** Bielski, B.H.J. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 6p. (CONF-870701—6). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012871.

From 8. international congress of radiation research; Edinburgh, UK (19 Jul 1987).

The chemistry of the superoxide radical (O_2^-) and its conjugate acid, the perhydroxyl radical (HO_2), is of increasing interest because of their key roles in many chemical processes involving oxygen or its derivatives. The current areas receiving the most attention are the biomedical field, industrial processes concerned with metal catalyzed oxidation/hydroxylation of organic compounds, radiation and uv-photolysis induced oxidations in the presence of oxygen, and chemistry that is concerned with pollution and atmospheric chemistry. A recent screening of publications on the reactivity of HO_2/O_2^- with other compounds in aqueous solutions, has resulted in the compilation of over four hundred rate constants. While approximately 300 of these have been tabulated (Bielski et al., 1985), the more recent data is available from the Radiation Chemistry Data Center (Ross, 1987). Since the effect of HO_2/O_2^- on biological systems has been reviewed extensively in numerous proceedings of recent international symposia, this report discusses briefly the role of HO_2 in acid rain formation and metal catalysis in superoxide chemistry.

41498 **(DOE/ER/13579—1) Variational transition state theory: Annual progress report for 1986.** Truhlar, D.G. (Minnesota Univ., Minneapolis (USA). Dept. of Chemistry). 1986. Contract FG02-86ER13579. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013073.

This project is concerned with the development and applications of generalized transition state theory and multidimensional tunneling approximations to chemical reaction rates. We have developed and implemented several practical versions of variational transition state theory (VTST), namely canonical variational theory (CVT), improved canonical variational theory (ICVT), and microcanonical variational theory (μVT). We have also developed and implemented several accurate multidimensional semiclassical tunneling approximations, the most accurate of which are the small-curvature semiclassical adiabatic (SCSA), large-curvature version-3 (LC3), and least-action (LA) approximations. We have applied the methods to thermal rate constants, using transmission coefficients based on ground-state tunneling, and we have also presented and applied adiabatic and diabatic extensions to calculate rate constants for vibrationally excited reactants. Our general goal is to develop accurate methods for calculating chemical reaction rate constants that remain practical even for reasonably complicated molecules. The approximations mentioned above yield rate constants for systems whose potential energy surface is known or assumed. Thus a second, equally important aspect of our work is the determination or modeling, semiempirically and/or from electronic structure calculations, of potential energy surfaces.

41499 **(Juel—2112) Calculation of physical properties of the gases O/sub 2/, N/sub 2/, CO, CO/sub 2/, He, H/sub 2/O, H/sub 2/, CH/sub 4/, CH/sub 3/OH and C/sub 2/H/sub 5/OH and of mixtures of these gases.** Kostka, N.; Hammeke, K. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorbauelemente). Jan 1987. 107p. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE87770230.

This report is concerned with the calculation of physical properties of the pure gases O/sub 2/, N/sub 2/, CO, CO/sub 2/, He, H/sub 2/O, H/sub 2/, CH/sub 4/, CH/sub 3/OH and C/sub 2/H/sub 5/OH and their mixtures. Equations are given for the following properties: Thermodynamic properties: density, specific heat capacity, enthalpy, entropy and velocity of sound; transport-coefficients: dynamic and kinematic viscosity, heat conductivity and diffusion-coefficient and Prandtl-number and Schmidt-number. A number of results is compared with experimental data to prove the reliability of the computer program. Especially the range of temperature and pressure which is of interest to the synthesis of methanol (273 K - 1273 K, 10/sup 5/ Pa - 3 x 10/sup 7/ Pa) is studied.

41500 **(LBL—23585) Reactive flux correlation functions and Monte Carlo evaluation of real time path integrals.** Miller, W.H. (Lawrence Berkeley Lab., CA (USA)). Jun 1987. Contract AC03-76SF00098. 18p. (CONF-870412—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012893.

From General meeting of the American Physical Society; Crystal City, VA, USA (20 Apr 1987).

The reactive flux correlation function provides a "direct" way to express the rate constant for a chemical reaction, i.e., it avoids having to solve first the complete state-to-state reactive scattering problem (and ten discard the state-to-state information). If the reaction dynamics is "direct," only the short time (of order $h\beta$) quantum dynamics is necessary to determine the rate. Longer time ($t >> h\beta$) dynamics is required if the dynamics is not "direct," and a new methodology is described for the Monte Carlo evaluation of real time path integrals for time up to two orders of magnitude longer than $h\beta/2$.

41501 **(LBL—23701) Dynamics of endoergic aromatic substitution reactions.** Robinson, G.N.; Continetti, R.E.; Lee, Y.T. (Lawrence Berkeley Lab., CA (USA)). Jun 1987. Contract AC03-76SF00098. 34p. (CONF-8709113—2). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87012894.

From Faraday discussion on dynamics of elementary gas phase reactions; Birmingham, UK (14 Sep 1987).

The endoergic substitution reactions Br + o-, m-, p-$CH_3C_6H_4Cl \rightarrow$ o-, m-, p-$CH_3C_6H_4Br$ + Cl ($\Delta H_0{}^0 \simeq 15$ kcal/mol) have been studied using the crossed beams method in the collision energy range 20 to 30 kcal/mol. o-chlorotoluene was found to be more reactive than p-chlorotoluene at the highest collision energy but the reverse was true below 25 kcal/mol. No reaction was observed for the meta isomer. An explanation for the lower reactivity of m-chlorotoluene is offered in terms of possible features of the potential energy surface. In all reactions, the products are forward scattered, indicating that the majority of collision complexes survive for less than one rotational period. This is understandable in light of the ~2 kcal/mol endoergicity to Br addition that results from the loss in resonance stabilization energy. Little of the energy available to the products of these reactions is channeled into translation. The experimental product translational energy distributions and excitation functions suggest that, in those complexes that decompose through Cl elimination, only a few vibrational degrees of freedom in the vicinity of the collision are involved in energy redistribution.

41502 **(ZfK—606) Adsorption of metals on metal surfaces and the possibility of its application in nuclear chemistry. Radiochemical (Z/Z+1)- and (Z/Z+2)-separations by thermic desorption from solid metal surfaces.** Roesch, F.; Eichler, B. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). Nov 1986. 14p. (In German). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702880.

The possibilities of the radiochemical separation of nuclides of metallic elements via thermic desorption from the surface of stationary metallic adsorbent were calculated. The influence of different physical parameters, of the nature of the adsorbent metals, of diffusion and side reactions was discussed. Suitable combinations of metals for the separations was maked up and checked with regard to the potential use as generator systems.

41503 **Kinetics of the polymerization of alkenes on zeolites.** Alberty, R.A. (Chemistry Department, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Journal of Chemical Physics;* **87**: No. 6, 3660-3667(15 Sep 1987).

The polymerization of alkenes at temperatures in the neighborhood of 600 K on a zeolite catalyst can be described in terms of a mechanism with bimolecular polymerization reactions and cracking reactions of isomer groups. The rate equations for the formation of isomer groups up to $C_{13}H_{26}$ have been integrated using the fourth-order Runge—Kutta method for polymerizations at constant temperature and pressure. In the absence of data on rate constants, calculations have been made on the basis of the assumption that all the bimolecular rate constants are equal or all the cracking constants are equal. In each case the rate constants for the reverse reactions have been calculated using the equilibrium constants for the steps in the mechanism. Under some circumstances the plots of weight fractions of isomer groups vs time have nearly the same shape for the two assumptions. However, it is possible to distinguish between the two assumptions by using experiments at sufficiently high pressures. The calculations show that it is of interest to examine the compositions arising from different starting materials, even though the equilibrium composition depends only upon temperature and pressure.

41504 **Exact time-dependent quantum mechanical dissociation dynamics of I_2He: Comparison of exact time-dependent quantum calculation with the quantum time-dependent self-consistent field (TDSCF) approximation.** Bisseling, R.H.; Kosloff, R.; Gerber, R.B.; Ratner, M.A.; Gibson, L.; Cerjan, C. (Department of Physical Chemistry and The Fritz Haber Research Center for Molecular Dynamics, The Hebrew University, Jerusalem 91904, Israel). *Journal of Chemical Physics;* **87**: No. 5, 2760-2765(1 Sep 1987).

The vibrational predissociation dynamics of a collinear model of the I_2(v)He cluster is studied by numerically exact time-dependent quantum mechanics, and by the time-dependent self-consistent field (TDSCF) approximation. The time evolution for the initial excitation levels v = 5, 11, 22 is explored. Excellent agreement is found between the TDSCF and the exact evolution of the wave packet; in particular the approximation reproduces well the dephasing events in the dynamics, and the measurable predissociation lifetimes. The results are very encouraging as to the applicability of quantum TDSCF as a quantitative tool in the study of van der Waals predissociation dynamics.

41505 **Hartree—Fock calculation of the electronic structure of a Cu^+ impurity in NaCl.** Winter, N.W.; Pitzer, R.M.; Temple, D.K. (Lawrence Livermore National Laboratory, Livermore, California 94550). *Journal of Chemical Physics;* **87**: No. 5, 2945-2953(1 Sep 1987). Contract W-7405-ENG-48.

Hartree—Fock cluster calculations have been carried out for the ground $3d^{10}$ and excited $3d^94s$ configurations of the Cu^+ ion in a NaCl host. Special emphasis has been given to providing an accurate representation of the Coulomb potential due to the remainder of the lattice. Configuration coordinate curves were determined for the symmetric displacement of the nearest-neighbor Cl^- ions and are compared to recent Xα calculations. The Hartree—Fock equilibrium Cu—Cl distance was found to be 5.327 bohr, slightly shorter than the calculated nearest-neighbor distance of 5.353 bohr for the pure NaCl host. Comparison of the Hartree—Fock and Xα ground and excited state energies, shows that the Xα approximation reverses the ordering of the $^3T_2$/sub g/ and ^1E/sub g/ states, overestimates the equilibrium nearest-neighbor distance, and predicts the a_1/sub g/ vibrational frequency to be about twice the Hartree—Fock value. Using the Franck—Condon factors found with the ab initio potential energy curves, the calculated bandwidths for the ^{1}/sup ,/$^3T_2$/sub g/ states are found to be in excellent agreement with the low-temperature absorption spectra.

41506 **Study of stereodynamics by variable-temperature ^{195}Pt NMR spectroscopy. Diastereomerism in platinum(II) thioether complexes and solvent effects.** Galbraith, J.A.; Menzel, K.A.; Ratilla, E.M.A.; Kostic, N.M. (Iowa State Univ., Ames). *Inorganic Chemistry;* **26**: No. 13, 2073-2078(1 Jul 1987). Contract W-7405-ENG-82.

New $[PtCl_3(thioether)]^-$ complexes have been synthesized with the following thioethers as unidentate ligands: N-formyl-DL-homomethionine (FHMetH), N-acetyl-L-methionine (AcMetH), N-acetyl-S-methyl-DL-cysteine (AcMeCysH), DL-3-(methylthio)-1,2-propanediol (MTPD), and DL-3-(methylthio)-2-butanone (MTB). These complexes constitute a series in which the length of the (CH_2)/sub x/ chain connecting the chiral carbon and sulfur atoms is varied systematically: x = 3,2,1,1, and 0, respectively. Each of the complexes exists in two diastereomeric forms, which are related by intramolecular inversion of configuration at the coordinated sulfur atom. The diastereomers are clearly evident in the ^{195}Pt NMR spectra, whose dependence on temperature yields the ΔG/sup double dagger/ values for inversion. Stereodynamic processes involving all but the simplest thioether ligands and processes resulting in subtle changes in molecular structure proved intractable by the common ^1H and ^{13}C NMR methods. The barrier to inversion depends on the solvating ability of the medium in an interesting way. Small amounts of diglyme in aqueous solution reduce the dif-

ference in chemical shifts between the ^{195}Pt NMR peaks of the diastereomers and thus lower the coalescence temperature, but they do not affect the barrier significantly, Large amounts of diglyme, however, lessen the stabilizing effect of hydration upon the thioether complex and lower the barrier. In unidentate complexes, which have flexible structures, the chiral C atom provides virtually no discrimination between the two configurations of the chiral S atom irrespective of the length of the (CH_2)/sub x/ chain between the two atoms. Significant discrimination is evident, however, in the bidentate complex cis-$[PtCl_2(MeCysH)]$. Steric constraint, such as that provided by chelation, seems to be a prerequisite for chiral discrimination.

41507 **Transition-metal compounds as new reagents for selective cross-linking of proteins. Synthesis and characterization of two bis(cytochrome c) complexes of platinum.** Peerey, L.M.; Kostic, N.M. (Iowa State Univ., Ames). *Inorganic Chemistry;* **26**: No. 13, 2079-2083(1 Jul 1987). Contract W-7405-ENG-82.

This study shows, for the first time, that proteins can be cross-linked selectively via transition-metal compounds to form stable protein complexes. Incubation of horse cytochrome c (designated cyt) with reagents $PtCl_4^{2-}$ with trans-$[Pt(2\text{-}Fpy)_2Cl_2]$ under mild conditions yields stable diprotein complexes trans-$[PtCl_2(cyt)_2]$ and trans-$[Pt(2\text{-}Fpy)_2(cyt)_2]$, respectively (2-Fpy is 2-fluoropyridine). The complexes are purified and characterized chromatographically. The protein molecules are coordinated to the Pt(II) atom through the thioether side chains of their respective Met 65 residues. Spectroscopic and electrochemical measurements indicate that, except for the slightly increased abundance of the high-spin form of ferriheme, the structural and redox properties of the cytochrome c molecules remain unaltered upon cross linking. The diprotein complexes are stable indefinitely under ordinary conditions and yet they can be cleaved, and the native protein restored, in a mild reaction. Platinum compounds hold promise as selective and versatile reagents for cross-linking of proteins. 54 references, 1 figure, 3 tables.

41508 **Assignment of the rhodium-rhodium stretching frequency in $Rh_2(O_2CCH_3)_4L_2$ complexes and the crystal and molecular structure of $[C(NH_2)_3]_2[Rh(O_2CCH_3)_4Cl_2]$. Relationship between vibrational spectra and structure.** Miskowski, V.M.; Dallinger, D.f.; Christoph, G.G.; Morris, D.E.; Spies, G.H.; Woodruff, W.H. (California Institute of Technology, Pasadena). *Inorganic Chemistry;* **26**: No. 13, 2127-2132(1 Jul 1987).

The resonance Raman spectra of salts of $[Rh_2(OAc)_4X_2]^{2-}$ (X = Cl^-, Br^-, I^-; OAc = O_2CCH_3) obtained by using ultraviolet laser excitation, and the structure of the salt $[C(NH_2)_3]_2[Rh_2(OAc)_4Cl_2]$, are reported. The salt crystallizes with two molecules per tetragonal (space group No. 87, I4/m) unit cell; a = 8.564 (1) A and c = 13.955 (1) A (T = -47 (1) °C). Least-squares refinement of 1395 unique reflections led to a final weighted $R(F^2)$ value of 0.053 (R(F) = 0.030). Significant results of the structure determination are the Rh-Rh, Rh-Cl, and Rh-O distances of 2.3959 (3), 2.5853 (6), and 2.042 (1) A, respectively. Ultraviolet resonance Raman results reveal that the rhodium-rhodium stretching motion of $[Rh_2(OAc)_4I_2]^{2-}$ is the predominant contributor to a normal vibrational mode observed at 314 cm^{-1}, rather than at 170 cm^{-1} as suggested in a previous assignment. In the bromide complex the analogous mode appears at 286 cm^{-1}. Simplified vibrational calculations yield a force constant of 2.60 mdyn/A for the Rh-Rh bond in the iodide complex. This force constant is consistent with a new comprehensive relationship between force constants and bond distances, while a force constant based upon nu(Rh-Rh) ~ 170 cm^{-1} is not. 24 references, 6 figures, 4 tables.

41509 **Synthesis, reactivity, and variable-temperature NMR studies of transition-metal complexes containing the 2,3-dihydrothiophene ligand.** Sauer, N.N.; Angelici, R.J. (Iowa State Univ., Ames). *Inorganic Chemistry;* **26**: No. 13, 2160-2164(1 Jul 1987). Contract W-7405-ENG-82.

The transition-metal complexes $W(CO)_5$(2,3-DHT) (1), $[Re(CO)_5(2,3\text{-}DHT)]SO_3CF_3$ (3), $PdCl_2$(2,3-DHT)$_2$ (4), and $Ru(CO)_3Cl_2$(2,3-DHT) (5) containing S-bound 2,3-dihydrothiophene (2.3-DHT), a proposed intermediate in thiophene hydrodesulfurization, have been prepared and characterized. Variable-temperature ^1H NMR studies of complexes 1, 3, and 5 establish that the barrier to inversion of the coordinated sulfur increases with the oxidation state of the metal: W(O) < Re(I) < Ru(II). In the series of $W(CO)_5(L)$ complexes, where L = 2,3-DHT, 2,5-DHT, and tetrahydrothiophene (THT), the inversion barriers decrease in the order 2,3-DHT (48.5 kJ/mol) > 2,5-DHT (45.6) > THT (43.9), which is also the order of decreasing ring strain in the sulfur ligands. Thus, the less strained the ligand, the more easily it achieves the planar transition state required for inversion. 30 references, 3 figures.

41510 **Reactions of electronically excited vinylidene radicals with molecular O_2.** Fahr, A.; Laufer, A.H. (National Bureau of Standards, Gaithersburg, MD). *Journal of the American Chemical Society;* **109**: No. 13, 3843(24 Jun 1987).

The rate constant and mechanism for the reaction between electronicallyexcited vinylidene (H_2C double bond C) $^3B_2$) and molecular oxygen has been examined at 297 K. The vinylidene radicals were produced from the vacuum UV flash photolysis of vinyl chloride. Reactant triplet vinylidene and products CO and formaldehyde were observed, in real time, by their characteristic absorption in the vacuum UV region. The two products were formed in equal amounts, and the reaction probably proceeds through a cyclic intermediate. The rate constants for reaction of D_2C double bond $C(^3B_2)$ with molecular oxygen and $O(^3P)$ atoms were (1.0 +/- 0.25) x 10^{-13} and (7 +/- 2) x 10^{-11} cm^3 $molecule^{-1}$ s^{-1}, respectively. The mechanism of the reaction of unsaturated hydrocarbon radicals with molecular O_2 is discussed.

41511 **Prescription for stabilization of ferromagnetic exchange in molecular solids via admixing of the ground state with a virtual charge-transfer excited state.** Miller, J.S.; Epstein, A.J. (E.I. du Pont de Nemours & Co., Inc., Wilmington, DE). *Journal of the American Chemical Society;* **109**: No. 13, 3850-3855(24 Jun 1987). Contract FG02-86ER45271.

A McConnell model for stabilization of ferromagnetic coupling in linear chains comprised of alternating radical cation donors, D, and radical anion acceptors, A, requires the admixture of a triplet excited state with the ground state. Such stabilization was proposed for forward, but not retro, charge transfer between an e^3 D (or A) and an A (or D) with one electron in a nondegenerate orbital. The electron configurations, via either forward or retro charge transfer, that stabilize ferromagnetic coupling are identified and tabulated for systems possessing singly, doubly, or triply degenerate partially occupied molecular orbitals, POMOs. The extended McConnell model and its mathematical embodiment as the generalized Hubbard model offer a convenient guide to explore ferro-, antiferro-, and ferrimagnetic phenomena in molecular (organic, organometallic, main group, polymeric, and/or inorganic coordination complex) systems. Assuming virtual charge transfer involves only the POMO, to achieve ferromagnetic coupling a stable radical (neutral, radical cations/radical anions, or radical ions with small diamagnetic counter ions) must possess a degenerate non-half-filled POMO. Additionally the lowest excited state formed via virtual charge transfer (retro or forward) must possess the same spin multiplicity as the ground state and admixes with the ground state to stabilize the ferromagnetically coupled ground state. Since ferromagnetism is a bulk phenomenon, to be achieved ferromagnetic coupling must be present and dominate throughout the solid.

41512 **Formation of ionic transition-metal carbonyl cluster fragments by ion-molecule reactions. 3. The heteronuclear systems.** Fredeen, D.J.A.; Russell, D.H. (Texas A & M Univ., College Station). *Journal of the American Chemical Society;* **109**: No. 13, 3903-3909(24 Jun 1987). Contract AS05-82ER13023.

The ion-molecule reaction chemistry of the $Co(CO)_3(NO)$/$Ni(CO)_4$, $Co(CO)_3(NO)$/$Fe(CO)_5$, and $Ni(CO)_4$/$Fe(CO)_5$ heteronuclear systems is presented. The relative reaction rate and cluster valence electron deficiency of the ionic cluster fragments are used to estimate the bond order of the ionic cluster fragments. The coordination unsaturation of the $Co(CO)_3(NO)$/$Ni(CO)_4$ system is very similar to the coordination unsaturation of the ionic cluster fragments found in the homonuclear $Cr(CO)_6$, $Fe(CO)_5$, $Co(CO)_3(NO)$, and $Ni(CO)_4$ systems. The ionic cluster fragments formed in the

$Co(CO)_3(NO)/Fe(CO)_5$ and $Ni(CO)_4/Fe(CO)_5$ systems seem to follow bonding patterns found in heterometallic systems containing $Fe(CO)_4^{2-}$.

41513 **Study of the ion-molecule reactions of the $Cr(CO)_5p$ anion with oxygen.** Bricker, D.L.; Russell, D.H. (Texas A & M Univ., College Station). *Journal of the American Chemical Society;* **109**: No. 13, 3910-3916(24 Jun 1987). Contract FG05-85ER13434.

The ion-molecule reactions of the $Cr(CO)_5^-$ anion with molecular oxygen are described. The $Cr(CO)_5^-$ anion reacts with O_2 to produce the $Cr(CO)_3O_2^-$ and $Cr(CO)_3O^-$ anions. The $Cr(CO)_3O_2^-$ anion reacts with neutral $Cr(CO)_6$ to reform $Cr(CO)_5^-$; whereas, the $Cr(CO)_3O^-$ anion reacts with O_2 to form CrO_3^-. The rate of reaction of $Cr(CO)_5^-$ shows an unusual temperature dependence. The temperature-dependent reaction rate is attributed to the formation of a high-spin state of $Cr(CO)_5$ by thermal decomposition of $Cr(CO)_6$. The mechanism of the reaction of $Cr(CO)_5^-$ with oxygen is probed by ($^{18}O_2$) isotopic labeling. The proton and electron affinities of the $Cr(CO)_3O_2^-$, $Cr(CO)_3O^-$, $Cr(CO)_3O^-$, and CrO_3^- anions are measured by using the bracketing method. In addition, the structures of the various anions are probed by using collision-induced dissociation (CID) methods, and the relative abundance of the CID fragment ions is used to estimate relative ligand binding energies for CO and O_2.

41514 **Formation of imidates, amides, amines, carbamates, and ureas from the $^+$a-NPh ligands of $Fe_3(\mu_3\text{-}NPh)_2(CO)_9$.** Williams, G.D.; Whittle, R.R.; Geoffroy, G.L.; Rheingold, A.L. (Pennsylvania State Univ., University Park). *Journal of the American Chemical Society;* **109**: No. 13, 3936-3945(24 Jun 1987).

The bis(nitrene) cluster $Fe_3(\mu_3\text{-}NPh)_2(CO)_9$ (1) reacts with $Li[HBEt_3]$, MeLi, PhLi, and NaOMe to form the formyl and acyl clusters $[Fe_3(\mu_3\text{-}NPh)_2(CO)_8C\{O\}R]^-$ (4, R = H; 6, R = Ph; 7, R = Me; 8, R = OMe). Formyl cluster 4 is unstable at room temperature and slowly loses CO to form the hydride cluster $[HFe_3(\mu_3\text{-}NPh)_2(CO)_8]^-$. The benzoyl cluster 7 reacts with EtOTf to yield the nitrene-carbene cluster $Fe_3(\mu_3\text{-}NPh)_2(CO)_8(C\{OEt\}Ph)$(9) which has been structurally characterized. The carbene and nitrene ligands in 9 couple to form the imidate PhN double bond C(OEt)Ph when 9 is exposed to air or allowed to stand in solution for prolonged periods under CO or N_2 atmospheres. Similar nitrene-benzoyl coupling from 7 gives benzanilide, and the methoxycarbonyl and nitrene ligands in 8 couple to give methyl N-phenylcarbamate when the clusters are oxidatively degraded with $[FeCp_2]^+$. The bis(phosphinidene) cluster $Fe_3(\mu_3\text{-}PPh)_2(CO)_9$ (2) also reacts with PhLi to yield a benzoyl derivative, $[Fe_3(\mu_3\text{-}PPh)_2(CO)_8(C\{O\}Ph)]^-$. However, addition of EtOTf to this species does not result in a carbene cluster analogous to 9, but instead phosphinidene-carbene coupling occurs to give $Fe_3(\mu_2\text{-}PPh)(\mu_3\text{-}PhPC\{OEt\}Ph)(CO)_9$ which has been structurally characterized. The phosphorus atom of the μ_3-PhPC{OEt}Ph ligand bridges two iron atoms, and the ethoxy-substituted carbon is attached to the third iron atom.

41515 **Chemical destruction of halogenated aliphatic hydrocarbons.** Rogers, C.J.; Kornel, A. (to Environmental Protection Agency, Washington, DC). US Patent 4,675,464. 23 Jun 1987. Filed date 9 Jul 1986. vp.

A method is described for the dehydrohalogenation of at least one halogenated aliphatic hydrocarbon having two carbon atoms, the method comprising: providing a reaction mixture by dissolving an alkali metal hydroxide in a molar excess of an ethylene glycol to form an alkali metal glycolate; the ethylene glycol is selected from the group consisting of diethylene glycol, triethylene glycol, tetraethylene glycol and pentaethylene glycol; and reacting the halogenated organic compound with the alkali metal glycolate to produce acetylene.

41516 **Dissociation kinetics of 1,10-diaza-4,7,13,16-tetraoxacyclooctadecane-N,N′-diacetic acid complexes of lanthanides.** Chang, C.A.; Sekhar, V.C. (Univ. of Texas, El Paso). *Inorganic Chemistry;* **26**: No. 12, 1981-1985(17 Jun 1987). Contract FG05-84ER13292.

The dissociation kinetics of 1,10-diaza-4,7,13,16-tetraoxacyclooctadecane-N,N′-diacetic acid (K22DA) complexes of lanthanide(III) ions were studied in perchloric acid and other media, over the concentration range 5×10^{-4} to 7.5×10^{-3} M and at a constant ionic strength of 0.1 M ($LiClO_4$). Copper (II) was used as the scavenger of free ligand, and the rates of dissociation of these complexes have been found to be independent of $[Cu^{2+}]$. All the complexes exhibit acid-dependent and acid-independent pathways in a manner similar to those of $LnCyDTA^-$ complexes (CyDTA = trans-1,2-diaminocyclohexane-N,N,N′,N′-tetraacetate ion). Unlike lanthanide (Ln) complexes of 1,7-diaza-4,10,13-trioxacyclopentadecane-N,N′-diacetic acid (K21DA), $LnK22DA^+$ complex dissociation rates are independent of [anion] and [electrolyte]. There is also no general-acid catalysis. The overall results are compared with those of complexes that are structural analogues such as $LnK21Da^+$, LnMEDTA (MEDTA = N-methyl-ethylenediamine-N,N,N′-triacetate ion), and $LnCyDTA^-$. A rationalization is given to account for similarities and differences with respect to observed kinetic characteristics. A number of postulates concerning the relationship between thermodynamic and kinetic stabilities and the detailed reaction mechanisms of lanthanide complxes of polyamino polyacetate ligands are proposed. 19 references, 1 figure, 7 tables.

41517 **Reactivity of $[Cu(TIM)]^{2+}$ with pyridine: formation constants determined by cyclic voltammetry.** Whitmoyer, D.E.; Rillema, D.P. (Univ. of North Carolina, Charlotte). *Inorganic Chemistry;* **26**: No. 12, 2012-2015(17 Jun 1987). Contract FG05-84ER13263.

The results of a study of the reactivity of $[Cu(TMD)]^{2+}$ where TMI id 2,3,9,10-tetramethyl-1,4,8,11-tetraazacyclotetradeca-1,3,8,10-tetraene) with pyridine in methylene chloride are reported here. The usefulness of the cyclic voltammetric simulation technique for determination of formation constants of values smaller than $\sim 10^7 M^{-1}$ is illustrated. The addition of pyridine to $[Cu(TMD)]^{2+}$ in methylene chloride resulted in smooth cyclic voltammetric changes with a single wave shift toward more negative values as the quantity of pyridine was increased indicating pyridine coordination to the copper complex ion. 14 references, 4 figures, 2 tables.

41518 **Low density microcellular foams.** Aubert, J.H.; Clough, R.L.; Curro, J.G.; Quintana, C.A.; Russick, E.M.; Shaw, M.T. (to Dept. of Energy, Washington, DC). US Patent 4,673,695. 16 Jun 1987. Filed date 8 Oct 1985. vp.

This patent describes a process for preparing a microporous, low-density foam having a nominal cell size of from about 1-20 micrometers and a density of less than about 0.1 g/cc comprising the steps of: forming a homogeneous initial solution of a polymer in a solvent at a temperature at which polymer is essentially completely soluble; cooling the solution at a rate such that the solution forms a phase-separated system comprising two distinct phases, each of which is continuous within the other. One phase comprises essentially the polymer and the other phase comprises essentially the solvent. The morphology of the polymer phase determines the morphology of the resultant foam; continuing the cooling at a rate such that the system retains essentially the same morphology it possessed at the point of phase separation and until the system is substantially entirely frozen; and removing the solvent to produce a foam. The improvement comprising: placing the initial solution in a chamber capable of subjecting it to essentially one-dimensional cooling; carrying out the cooling in one-dimensional fashion which comprises cooling the solvent system from essentially one direction so that the solution is subjected to cooling on only one side, as opposed to two or more sides; and means are provided to insulate the solution from heat transfer from any direction except the intended one.

41519 **Spectroscopic evidence for the involvement of OH groups in the formation of Rh/sup I/$(CO)_2$ on metal oxide supports.** Basu, P.; Panayotov, D.; Yates, J.T. Jr. (Univ. of Pittsburgh, PA). *Journal of Physical Chemistry;* **91**: No. 12, 3133-3136(4 Jun 1987).

Specific OH(a) groups on Al_2O_3 or SiO_2 are consumed as CO interacts with supported Rh crystallites to produce Rh/sup I/$(CO)_2$(a). The reaction $Rh^0 + \text{-OH(a)} + 2CO(g) \rightarrow$ Rh/sup I/$(CO)_2$(a) + 1/2 H_2(g) has been shown to involve isolated OH(a) groups rather than H-bonded associated OH(a) species. This reaction can be reversed by using H_2(g) to destroy Rh/sup I/$(CO)_2$

with regeneration of the isolated OH(a) species. Comparative kinetic studies of OH(a) and OD(a) species indicate that the rate-controlling step in the production of Rh/sup I/$(CO)_2$(a) does not exhibit a measurable isotope effect.

41520 **Dissociation energies of the benzene dimer and dimer cation.** Grover, J.R.; Walters, E.A.; Hui, E.T. (Brookhaven National Lab., Upton, NY). *Journal of Physical Chemistry;* **91**: No. 12, 3233-3237(4 Jun 1987). Contract AC02-76CH00016.

The dissociation energy of the benzene dimer was measured indirectly via a precision measurement of its ionization potential, using tunable synchrotron radiation and an argon-benzene nozzle beam optimized for $(C_6H_6)_2$. This ionization potential, 8.690 +/- 0.023 eV (1427 +/- 4A), was combined with other data from the literature to obtain $D_0([C_6H_6]_2)$ = 2.4 +/- 0.4 kcal mol^{-1} and $D_0([C_6H_6]_2^+)$ = 15.3 +/- 0.9 kcal mol^{-1}. The corresponding heats of formation are $\Delta H/sub\ f/^0\ _0([C_6H_6]_2)$ = 30.4 +/- 0.4 kcal mol^{-1} and $\Delta H/sub\ f/^0\ _0([C_6H_6]_2^+)$ = 230.8 +/- 0.9 kcal mol^{-1}. The threshold portion of the photoionization efficiency function of $(C_6H_6)_2$ shows no sign of autoionizing Rydberg structure, so direct ionization is the process that determines the threshold function shape. This shape also indicates that the geometry of $(C_6H_6)_2$ is significantly different from that of $(C_6H_6)_2^+$, which is thought to have a sandwich structure, but is still sufficiently similar to permit the threshold to be distinctly observed.

41521 **Collisional quenching of $CH_3O(A^2A_1)$.** Wantuck, P.J.; Oldenborg, R.C.; Baughcum, S.L.; Winn, K.R. (Los Alamos National Lab., NM). *Journal of Physical Chemistry;* **91**: No. 12, 3253-3259(4 Jun 1987).

Room temperature rate constants for collisional quenching of $CH_3O(A^2A_1)$ have been measured for 20 collision partners. Methoxy radicals are produced by 248-nm photolysis of CH_3ONO and the $CH_3O(A^2A_1)$ is produced by exciting the A-X transition using a pulsed dye laser. Rate constants are determined by monitoring the time-resolved fluorescence signal as a function of quenching gas pressure. The experimental quenching cross sections are best correlated in terms of the CH_3O-collision partner interaction well depth. Reasonable correlation is observed for 15 quenching gases, but several exceptions are apparent. A similar trend in collision partner quenching efficiency for $OH(A^2Sigma^+)$ and $CH_3O(A^2A_1)$ is noted and discussed.

41522 **Hydration of polar organic molecules: the interaction of acetonitrile with water.** Damewood, J.R. Jr.; Kumpf, R.A. (Univ. of Delaware, Newark). *Journal of Physical Chemistry;* **91**: No. 12, 3449-3452(4 Jun 1987).

The hydration of acetonitrile (1) is investigated by ab initio techniques at the 3-21G, 6-31G**//3-21G, and 6-31G**//6-31G** level of sophistication. Considered are 1:1 complexes formed between 1 and water. Hydrogen bonding to both the nitrile nitrogen (1a) and the π bond of the nitrile moiety (1b) is investigated. 1b is found not to be a minimum on the 3-21G or 6-31G** potential energy surface. Water interacting with 1 via the methyl region is investigated by considering the possibility of C-H...O hydrogen bonding (1c) and bonding to the cavity formed by the three C-H bonds of the methyl group (1d). At the highest level of sophistication (6-31G**//6-31G**), 1c is not found to be a minimum on the potential energy hypersurface. A side-by-side complex (1e) in which water is oriented approximately parallel with the nitrile moiety is also considered. The interaction energies for these complexes at the 6-31 G**//6-31G** level of sophistication are as follows: 1a, 4.3 kcal/mol; 1e, 4.1 kcal/mol; 1d, 2.3 kcal/mol.

41523 **Syntheses, reactions, and structures of dioxycarbene complexes of rhenium.** Miessler, G.L.; Kim, S.; Jacobson, R.A.; Angelici, R.J. (Iowa State Univ., Ames). *Inorganic Chemistry;* **26**: No. 11, 1690-1695(3 Jun 1987). Contract W-7405-ENG-82.

The cyclic dioxycarbene complex $Re(CO)_4Br(COCH_2CH_2O)$ (I) reacts with PPh_3 to give initially fac-$Re(CO)_3(PPh_3)Br(COCH_2CH_2O)$ (II) and upon further reaction $Re(CO)_2(PPh_3)_2Br(COCH_2CH_2O)$ (II). The reaction of I with the diphosphines $Ph_2P(CH_2)$/sub n/PPh_2 (n = 1,2) gives the diphosphine-bridged complexes $[Re(CO)_3Br(COCH_2CH_2O)]_2(Ph_2P(CH_2)$/sub n/$PPh_2)$ (IV, n = 1; V, n = 2). The structures of I and V were established by X-ray diffraction studies. The crystals of I are orthorhombic, space group Pbca, with a = 11.764 (2) A, b = 17.579 (4) A, c = 10.658 (2) A, and Z = 8, while those of V are triclinic, space group P anti I, with a = 11.160 (2) A, b = 11.369 (3) A, c = 10.090 (3) A, α = 111.58 (3)°, β = 95.40 (2)°, γ = 92.78 (2)°, Z = 1, and two acetones ($(CH_3)_2CO$) of crystallization. The dimethyldithiocarbamate ion, $^-S_2CN(CH_3)_2$, reacts with I to remove in effect ethylene oxide form the carbene ligand, giving $Gr(CO)_5Br$ and $HOCH_2CH_2SC(=S)N(CH_3)_2$.

41524 **Interlamellar chemistry of hydrotalcites. I. Polymerization of silicate anions.** Schutz, A.; Biloen, P. (Univ. of Pittsburgh, PA). *Journal of Solid State Chemistry;* **68**: No. 2, 360-368(Jun 1987). Contract FG22-84PC70808.

Exchange of silicate anions into hydrotalcite-type materials leads to the ready formation of well-ordered two-dimensional silicate sheets. The combined evidence from diffraction, NMR, and IR allows for a global identification of the reaction product. Its structure probably consists of positively charged brucitelike layers intercalated with puckered, silicic-acid-type macroanions.

41525 **The behavior of water in molten salts.** White, S.H.; Twardoch, U.M. (EIC Labs., Inc., Norwood, MA). *Journal of the Electrochemical Society;* **135**: No. 5, 1080-1087(May 1987).

The different behavior of water equilibrated with three separate molten salt solvents is discussed with respect to the chemistry of the solutions and the electroreductive mechanisms at gold electrodes. In the case of the equimolar mixture of KNO/sub 3-/NaNO/sub 3/, water dissolves without chemical reaction with the solvent in contrast to the behavior in the Li/sub 2/SO/sub 4-/Na/sub 2/SO/sub 4-/K/sub 2/SO/sub 4/ [78-8.5-13.5 mole percent (m/o)] and the Li/sub 2/CO/sub 3-/Na/sub 2/CO/sub 3-/K/sub 2/CO/sub 3/ (43.5-31.5-25 m/o) where reaction to form bisulfate, bicarbonate, and hydroxide takes place. The mechanism of the reduction of water in the nitrate melt is shown to take place by means of parallel E/sub 1/C/sub 1/E/sub 2/ and E/sub 1/C/sub 2/ pathways in which E/sub 1/ < E/sub 2/.

41526 **Catalysis: new perspectives from surface science.** Goodman, D.W.; Houston, J.E. (Sandia National Labs., Albuquerque, NM). *Science (Washington, D.C.);* **236**: 403-409(24 Apr 1987). Contract AC04-76DP00789.

One-sixth of the value of all goods manufactured in the US involves catalytic processes. However, in spite of this dramatic economic impact, little is known about this broad subject at the molecular level. In the last two decades a variety of techniques have been developed for studying at the atomic level the structure, composition, and chemical bonding at surfaces. These techniques have been used to study adsorption and reaction on metal single crystals in an ultrahigh vacuum environment or to analyze catalysts before and after reaction. An important new development has been the coupling of an apparatus for the measurement of reaction kinetics at elevated pressures with an ultrahigh vacuum system for surface analysis. This approach has demonstrated that metal single crystals can be used to successfully model many important catalytic reactions and has established a direct link between the results of ultrahigh vacuum surface measurements and the chemistry that occurs under typical catalytic-processing conditions. In this article they highlight the application of surface science to several pivotal questions related to heterogeneous catalysis. This article is not intended to be a broad review of surface science or of its application to the area of catalysis. Rather, they concentrate on specific applications and use work by the authors to illustrate the impact that surface science can have on understanding surface-catalyzed reactions.

41527 **Laser-based ionization analyses at Pacific Northwest Laboratory.** Whitaker, T.J.; Cannon, B.D.; Gerke, G.K.; Bushaw, B.A. (Pacific Northwest Lab., Richland, WA 99352). pp TuB4.1-TuB4.4 of Topical meeting on laser applications to chemical analysis (Technical Digest). Washington, DC; Optical Society of America (1987). (CONF-870119—). Contract AC06-76RL01830.

From Topical meeting on laser applications to chemical analysis; Lake Tahoe, NV, USA (26 Jan 1987).

Pacific Northwest Laboratory (PNL) has several projects dedicated to developing new resonance ionization techniques and the study of related basic processes. The two techniques described here differ from most resonance ionization experiments in that the lasers used for resonant excitation are not required to photoionize the excited state atom. This permits excellent sensitivity to be achieved even when relatively weak lasers are used for the resonance steps. In one case, continuous wave (cw) lasers provide isotopically selective resonant excitation and a medium intensity infrared laser ionizes the excited atoms. In the other case, pulsed lasers are used for resonant excitation, and collisions with an inert buffer gas produce ionization. The merits of these techniques are discussed.

41528 **Atomic vapor density monitor.** Sewall, N.; Harris, W.; Beeler, R.; Wooldridge, J.; Chen, H. (Lawrence Livermore National Lab., P.O. Box 808, Livermore, CA 94550). pp WA5.1-WA5.4 of Topical meeting on laser applications to chemical analysis (Technical Digest). Washington, DC; Optical Society of America (1987). (CONF-870119—). Contract W-7405-ENG-48.

From Topical meeting on laser applications to chemical analysis; Lake Tahoe, NV, USA (26 Jan 1987).

The atomic vapor density monitor (AVDM) system measures absorption of light from a swept-wavelength laser that passes through an atomic vapor stream. This vapor stream is above the surface of a crucible-contained melt in an atomic-vapor generator. The AVDM system calculates vapor density by integrating the spectral-absorption peaks. The values provide a voltage-feedback signal to the heating control system. If the AVDM detects a decrease in the vapor density in the generator, the heater current increases automatically to maintain a constant vaporization rate. The author's calculation of vapor density is based on the exponential relationship between the vapor density and the absorption of laser light passing through the atomic vapor stream. This relationship holds when the laser wavelength is tuned to an optical transition of the vaporized atoms. During the development of the AVDM system, the authors made observations which are presented in this paper.

41529 **Study on synthetic methods of trialkyl phosphate oxide and its extraction behavior of some acids.** Yu, M.J.; Su, Y.F. (East China Institute of Chemical Technology, Shanghai). *Separation Science and Technology;* **22**: No. 2/3, 315-323(1987). (CONF-851011—).

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

Trioctyl phosphine oxide (TOPO) is useful for the extraction of many inorganic and organic compounds. A mixed trialkyl phosphine oxide (TRPO) is similar in property to TOPO. The total number of carbon atoms per molecule of TRPO ranges from 15 to 27. Three methods for synthesizing TRPO are described in this paper. When TRPO is synthesized from an alcohol mixture it is significantly cheaper than a single pure alcohol as required for the production of TOPO; tedious purification steps are eliminated. TRPO is a brown liquid which is very slightly soluble in water. Toxicological measurements of LD50, AMES test, hereditary and accumulative toxicity show that TRPO is safe for use in the extraction of some pharmaceutical and biochemical compounds. Examinations of IR and NMR show that the complex interaction of P=O bond of TRPO with extracted substances is the same as that of TOPO. The distribution coefficients of phosphoric acid, citric acid, malic acid, oxalic acid, and tartaric acid with TRPO are reported. The extraction of these acids is believed to proceed by neutral-complex mechanism.

41530 **Kinetics of the complexation of ferric iron with 8-hydroxyquinoline and KELEX 100.** Ki, K.Y; Lemert, R.M.; Chang, H.K. (Lamar Univ., Beaumont, TX). *Separation Science and Technology;* **22**: No. 2/3, 513-533(1987). (CONF-851011—).

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

The complexation reactions of ferric iron with 8-Hydroxyquinoline and KELEX-100 in both aqueous and methanol solutions were studied by using a stopped-flow spectrophotometer. In the aqueous solutions, the observed rate law was found to be first-order with respect to both iron(III) and oxine and inverse-first-order with respect to the hydrogen ion. While in the methanol solution, the rate law was first-order with respect to iron(III) and KELEX-100. Reaction pathes with the formation of the first complex, FeA^{2+}, from either Fe^{3+} or $Fe(OH)^{2+}$ were proposed to explain the observed rate law. The activation energies were found to be 5.5 kcal/g-mole and 15 kcal/g-mole for the aqueous and methanol solutions, respectively.

41531 **FLOSHEET: microcomputerized flowsheeting/simulation program for simulating hydrogen isotope separation processes.** Busigin, A.; Sepa, T.R.; Sood, S.K. (Ontario Hydro, Toronto). *Separation Science and Technology;* **22**: No. 2/3, 557-579(1987). (CONF-851011—).

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

Ontario Hydro has developed a comprehensive computer program, FLOSHEET, to simulate various hydrogen isotope separation processes, including water distillation and cryogenic distillation of elemental hydrogen isotopes. FLOSHEET was developed to assist in the operation and optimization of a Tritium Removal Facility Ontario Hydro is building at the Darlington Nuclear Generating Station. However, FLOSHEET is a general purpose simulator and allows the specification and simulation of complete process plants with various interconnected units. This paper discusses the development and features of FLOSHEET, as well as various simulation results which have emerged from the use of the program.

41532 **Effect of macrocycle type on Pb^{2+} transport through an emulsion liquid membrane.** Izatt, R.M.; Bruening, R.L.; Clark, G.A.; Lamb, J.D.; Christensen, J.J. (Brigham Young Univ., Provo, UT). *Separation Science and Technology;* **22**: No. 2/3, 661-675(1987). (CONF-851011—). Contract FG02-86ER13463.

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

The relative effectiveness of 14 different macrocycles in transporting $Pb(NO_3)_2$ has been determined at 25°C using a water-toluene-water emulsion membrane system. The largest amount of Pb^{2+} transport was found with didecyl-1, 10-diaza-18-crown-6 (91%), followed by dicyclohexano-18-crown-6 (81%), di-tert-butyldicyclohexano-18-crown-6 (77%), 1,10-diaza-18-crown-6 (27%), and cryptand 2.2.1(4,7,13,16,21,24-pentoxa-1,10-diazabicyclo(8,8,5)-tricosane) (16%). The use of the other macrocycles produced little Pb^{2+} transport. Analysis of the transport results shows that, for most effective transport, the macrocycle should distribute preferentially to the organic phase and the log K value for the binding of the macrocycle with Pb^{2+} must be large enough for quantitative extraction of the Pb^{2+} into the membrane. However, this log K value must be sufficiently smaller than that for interaction of Pb^{2+} with $P_2O_7^{4-}$, the receiving phase complexing agent, to allow a large Pb^{2+} concentration gradient to be established. These features provide information which should be useful in designing systems for cation separations using emulsion membranes.

41533 **Transport of $AgBr^{2-}$, $PdBr_4^{2-}$, and $AuBr_4\surd$ in an emulsion membrane system using K+-dicyclohexano-18-crown-6 as carrier.** Izatt, R.M.; Clark, G.A.; Christensen, J.J. (Brigham Young Univ., Provo, UT). *Separation Science and Technology;* **22**: No. 2/3, 691-699(1987). (CONF-851011—).

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

Silver, palladium, and gold have been transported through a 1.5 M KBr/toluene/0.25 M MgS_2O_3 (or $Mg(NO_3)_2$) emulsion membrane system as $AgBr_3^-$, $PdBr_4^{2-}$, and $AuBr_4^-$, respectively, using K+-dicyclohexano-18-crown-6(DC18C6) as carrier. The transport studies are carried out in $AgBr_3^-$, $PdBr_4^{2-}$, and $AuBr_4^-$ single solutions and in $AgBr_3^-/PdBr_4^{2-}$, $AgBr_2^-/AuBr_4^-$, and $PdBr_4^{2-}/AuBr_4^-$ binary solutions. The presence of DC18C6 in the toluene membrane is found to greatly enhance ion transport. When MgS_2O_3 is in the receiving phase, $AuBr_4^-$ is found to transport well even without DC18C6 in the membrane. The transport of $AgBr_3^-$, $PdBr_4^{2-}$, and $AuBr_4^-$ is greater for those systems containing MgS_2O_3 in the receiving phase than for those with $Mg(NO_3)_2$. In

binary studies with MgS_2O_3 in the receiving phase, $PdBr_4^{2-}$ is transported selectively over $AgBr_2^-$ and $AuBr_4^-$ is transported selectively over either $PdBr_4^{2-}$ or $AgBr_2^-$.

41534 Macrocycle-mediated transport in a bulk 1.5 M HNO_3-$CHCl_3$-0.01 M HNO_3 membrane system of Pd^{2+} and Mn^+ from Pd^{2+}-Mn^+ mixture. Izatt, R.M.; Eblerhardt, L.; Clark, G.A.; Bruening, R.L.; Bradshaw, J.S.; Cho, M.H.; Christensen, J.J. (Brigham Young Univ., Provo, UT). *Separation Science and Technology;* **22**: No. 2/3, 701-710(1987). (CONF-851011—).

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

Pd^{2+} has been transported using sulfur substituted macrocycles as carriers and several M/sup n+/ (M/sup n+/ = Li^+, Na^+, K^+, Rb^+, Cs^+, Mg^{2+}, Ca^{2+}, Sr^{2+}, Ba^{2+}, Ag^+, Tl^+, Cd^{2+}, and Pb^{2+}) have been transported using 18-crown-6 (18C6) and sulfur substituted macrocycles as carriers in a 1.5M HNO_3/$CHCl_3$/0.01M HNO_3 bulk liquid membrane system. Competitive Pd^{2+}-M/sup n+/ transport studies have also been carried out for the same systems. The cyclic polyether 18C6 transports M/sup n+/ selectively over Pd^{2+} for all M/sup n+/ except Li^+, Mg^{2+}, and Cd^{2+}. In the cases of these three cations, no transport was found for either Pd^{2+} or M/sup n+/. Generally, the sulfur substituted macrocycles transport Pd^{2+} selectively over M/sup n+/.

41535 Kinetics of formation and transport resistances of zirconium-monobutyl phosphate films. Freeman, R.W.; Marcos, B.; Dillon, J.; Demetropoulos, H. (Rutgers-State Univ. of New Jersey, Piscataway). *Separation Science and Technology;* **22**: No. 2/3, 791-800(1987). (CONF-851011—).

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

The formation processes of monobutyl phosphate-zirconium films at a liquid-liquid interface have been investigated by observing changes in toluene absorption in a Lewis cell type contactor. Films were formed by adding monobutyl phosphate to the upper (organic) phase and allowing it to react with zirconium dissolved in the lower (aqueous) phase while monitoring the absorption of the organic solvent into the aqueous phase. Results indicate that the film formation occurs over a short period of time but may be preceded by a considerable lag period which depends on concentration, temperature and to a lesser extent, stirring. Mass transfer coefficients were decreased by as much as 40% at higher temperatures. Interfacial tension changes during film formation were also investigated and indicate that significant activity occurs at the interface.

41536 Liquid-liquid extraction of low molecular-weight proteins by selective solubilization in reversed micelles. Goklen, K.E.; Hatton, T.A. (Massachusetts Institute of Technology, Cambridge). *Separation Science and Technology;* **22**: No. 2/3, 831-841(1987). (CONF-851011—).

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

The effects of pH and salt concentration on the solubilization of ribonuclease-a, cytochrome-c and lysozyme in Aerosol OT/isooctane reversed micelle solutions have been studied to explore the potential for employing this solvent system in the large-scale recovery and concentration of proteins using liquid extraction. For pH values below the isoelectric point, pI, of the protein, solubilization was high, probably owing to strong electrostatic interactions between the positively charged proteins and the anionic surfactant heads forming the inner micelle wall. Above the pI, the proteins could not be solubilized, probably because of unfavorable electrostatic repulsions between the like-charged proteins and surfactants. At low ionic strength and neutral pH, complete solubilization of the proteins was observed. As the ionic strength was increased, there was an abrupt decrease in solubilizing power of the reversed micelle solutions; the salt concentration at which this occurred was different for each protein. A mixture of the three proteins was cleanly resolved using a single extraction step and two stripping steps. The conditions in each step were selected according to the results of the single protein extraction studies.

41537 Calcium isotope effect in calcium ion exchange with a fluid phase containing a macrocyclic compound. Jepson, B.E.; Evans, W.F. (MRC-Mound, Miamisburg, OH). *Separation Science and Technology;* **22**: No. 2/3, 1029-1035(1987). (CONF-851011—). Contract AC04-76DP00053.

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

The separation coefficient for calcium isotope exchange with a macrocyclic polyether was measured by ion exchange chromatography. The isotopic enrichment proceeds according to the chemical exchange reaction: $^{44}CaL^{2+}$/sub Fluid +/$^{40}Ca^{2+}$/sub Resin/ $\rightleftharpoons$ $^{40}CaL^{2+}$/sub Fluid +/$^{44}Ca^{2+}$ where L represents the macrocyclic polyether 18-crown-6. The observed separation coefficient for the calcium 40/44 isotope pair, epsilon(40/44), was 4.9×10^{-4} (+/- 1.3×10^{-4}, 95% C.L.) with calcium-40 enriched in the fluid phase. A sulfonic acid resin was used with a fluid phase consisting of a 70/30 volume percent mixture of ethanol and water. The isotope effect was smaller than metal-crown isotope effects reported in the literature, and possible reasons for this are discussed.

41538 Solubilities in supercritical fluids: the application of chromatographic measurement methods. Smith, R.D.; Udseth, H.R.; Wright, B.W.; Yonker, C.R. (Pacific Northwest Lab., Richland, WA). *Separation Science and Technology;* **22**: No. 2/3, 1065-1086(1987). (CONF-851011—). Contract AC06-76RL01830.

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

New methods are described for the measurement of the solubilities of solids in supercritical fluids. These methods utilize instrumentation developed for capillary supercritical fluid chromatography consisting of deactivated, small diameter, fused silica tubing, coupled with detection methods based upon on flame ionization and mass spectrometric detectors. The methods involve (a) direct solubility determination where the fused silica capillary is used as an equilibrium cell, and (b) a pressure of threshold solubility technique which resembles chromatography and uses a programmed pressure increase and sensitive detection to determine the onset of solute migration. Results are also presented which suggest that solubilities can be determined, within certain limitations, from actual chromatographic experiments. The methods are illustrated using aromatic hydrocarbons and complex mycotoxins of the trichothecene group.

41539 Calorimetric method for the determination of binary phase compositions at high temperatures and pressures. Cordray, D.R.; Christensen, J.J.; Izatt, R.M. (Brigham Young Univ., Provo, UT). *Separation Science and Technology;* **22**: No. 2/3, 1169-1181(1987). (CONF-851011—). Contract AC02-82ER13024.

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

The design and operation of supercritical separation equipment are dependent upon an accurate knowledge of phase equilibria among the components involved in the processes. Using high-pressure, high-temperature flow calorimeters, they have developed a method for determining phase splitting in binary mixtures from heat-of-mixing data taken in the region of the mixture critical locus. The flow calorimetric procedure for determining heats of mixing, phase equilibria, and the critical locus curve is described. The advantages and simplicity of using flow calorimetry to determine these data are discussed. Phase behavior of several binary CO_2-hydrocarbon systems is presented.

41540 Thermal rate constant for $H + CH_3 \rightarrow CH_4$ recombination. 3. Comparison of experiment and canonical variational transition state theory. Hase, W.L.; Mondro, S.L.; Duchovic, R.J.; Hirst, D.M. (Wayne State Univ., Detroit, MI). *Journal of the American Chemical Society;* **109**: No. 10, 2916-2922(1987).

Canonical variational transition state theory is used to calculate bimolecular rate constants for $H + CH_3$ and $D + CH_3$ recombination. The calculations are performed on an analytic potential energy surface derived from recent ab initio calculations. Rate constants calculated for this surface are in very good agreement with the experimental values. The H(D)---CH_3 transitional rocking modes are treated as quantum harmonic oscillators or classical hin-

dered rotors in the calculations. These two treatments give rate constants which agree to within 15%. The variational transition states become tighter as the temperature is increased.

41541 **Excited state excimer spectroscopy.** Eden, J.G. (Univ. of Illinois, Urbana, IL 61801). pp 109-116 of Excimer lasers and optics. Luk, T.S. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-8609127—).

From SPIE symposium on optics and optoelectronics; Cambridge, MA, USA (14 Sep 1986).

Recent experiments are described in which the electronic excited state structure of the rare gas dimers (Rg/sub 2/), the triatomic rare gas-halide molecules Kr/sub 2/F and Xe/sub 2/Ciota, and the heteronuclear KrAr have been studied in absorption or by laser induced fluorescence. One key aspect of these spectroscopic experiments is that the excited states are probed near their equilibrium radii. Measurements of the absolute photoionization cross-sections for the lowest l/sub μ/, O/sub μ/sup -// states of Kr/sub 2/ and Xe/sub 2/ are also discussed.

41542 **Laser spectroscopy and its applications.** Radziemski, L.; Solarz, R.; Paisner, J. (eds.). New York, NY; Marcel Dekker (1987). 701p. Marcel Dekker, 270 Madison Ave., New York, NY 10016 $99.75.

From review by John C. Wright, Univ. of Wisconsin, in Analytical Chemistry, Vol. 59, No. 11(1 Jun 1987).

This book presents seven broad applications of lasers in such a way that experts in laser technology and beginning scientists unfamiliar with the field can rapidly understand the important developments in these areas. The applications selected reflect those considered most relevant today by Lawrence Livermore National Laboratories. Applications include resonance photoionization, photodissociation and the related laser chemistry, laser-induced plasmas, laser absorption spectroscopy, laser-excited fluorescence, coherent and incoherent Raman techniques, and remote sensing. There are also two chapters that provide background material on the theoretical foundations of spectroscopy and on the principles of the common lasers.

4004 Electrochemistry

REFER ALSO TO CITATION(S) 41086, 41133, 41481, 41486, 41490, 41525

41543 **(CONF-870839—1) Electrochemical cell and electrode designs for high-temperature/high-pressure kinetic measurements.** Nagy, Z.; Yonco, R.M. (Argonne National Lab., IL (USA)). May 1987. Contract W-31109-ENG-38. 29p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011395.

From 3. international symposium on environmental degradation of materials in nuclear power systems: water reactors; Traverse City, MI, USA (30 Aug 1987).

Many corrosion processes of interest to the nuclear power industry occur in high-temperature/high-pressure aqueous systems. The investigation of the kinetics of the appropriate electrode reactions is a serious experimental challenge, partially because of the high temperatures and pressures and partially because many of these reactions are very rapid, requiring fast relaxation measurements. An electrochemical measuring system is described which is suitable for measurements of the kinetics of fast electrode reactions at temperatures extending to at least 300°C and pressures to at least 10 MPa (100 atmospheres). The system includes solution preparation and handling equipment, the electrochemical cell, and several electrode designs. One of the new designs is a coaxial working electrode-counter electrode assembly; this electrode can be used with very fast-rising pulses, and it provides a well defined, repeatedly-polishable working surface. Low-impedance reference electrodes are also described, based on electrode concepts responding to the pH or the redox potential of the test solution. Additionally, a novel, long-life primary reference electrode design is reported, based on a modification of the external, pressure-balanced Ag/AgCl reference electrode.

41544 **Anodic dissolution of iron in acidic sulfate electrolytes. II. Mathematical model of current oscillations observed under potentiostatic conditions.** Russell, P.; Newman, J. (Weyerhaeuser Technology Center, Tacoma, WA). *Journal of the Electrochemical Society;* **135**: No. 5, 1051-1058(May 1987).

A mathematical model describing sustained oscillations observed in the iron-sulfuric acid system, under potentiostatic conditions, is presented. This model assumes that the sustained oscillations are due to a continuous cycling of a portion of the electrode between the active and the passive states. The electrode surface is covered by a porous ferrous sulfate film. Transient changes in the potential and concentration profiles in the pores of the salt film and in the diffusion layer are responsible for the continuous cycling. A one-dimensional model that describes these processes is presented. Results from this model are compared to the experimental current-time curves. The calculated current-time curve shows oscillatory behavior. The characteristics of the calculated current-time curve differ from experimental results.

4005 Photochemistry

REFER ALSO TO CITATION(S) 41510, 41521, 41549

41545 (LBL—22151, pp 1.33-1.35) **Sub-micromolar actinide detection via photoacoustic spectroscopy.** Russo, R.E.; Silva, R.J. Mar 1987. NTIS, PC A02/MF A01. File Number DE87009270. Contract AC03-76SF00098.

In Energy Conversion and Storage Program: FY 1986, Annual report.

Photoacoustic spectroscopy (PAS) is an ultrasensitive absorption technique capable of providing non-destructive characterization of atomic and molecular systems. PAS measurements are based on a periodic optical absorption in a sample followed by nonradiative conversion of the absorbed energy into heat. A subsequent heat-induced thermal expansion produces a pressure or acoustic wave in the sample medium whose amplitude is measured by a suitable transducer. The amplitude of this photoacoustic wave is directly related to the optical absorption of the sample, and, therefore, the concentration of absorbing species. In this work, PAS was demonstrated as a sensitive technique for measuring micromolar and lower concentrations of rare earth and actinide ions in aqueous solution. In near-neutral solutions, actinide ions are sparingly soluble ($< 10^{-7}$ M) chemical methods used for the measurement of actinides at submicromolar concentrations, such as extraction and ion exchange, disturb the natural equilibria. An optical technique such as PAS facilitates direct measurement without disturbing the chemical equilibria.

41546 **Studies of chemical reactivity in the condensed phase. III. Direct measurement of predissociation and geminate recombination times for iodine in solution.** Smith, D.E.; Harris, C.B. (Department of Chemistry, University of California, Berkeley, California 94720 and Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Journal of Chemical Physics;* **87**: No. 5, 2709-2715(1 Sep 1987).

Results are presented which clarify the time scales for predissociation and geminate recombination in the iodine photodissociation/recombination reaction. Direct comparison of absorption features following A state excitation with those following B state excitation suggests that predissociation may be much more rapid (≦ 1 ps) than previously thought, and that geminate recombination is also very rapid (≦ 2 ps). Both of these results lead to the conclusion that curve crossing in solution is extremely facile and not the rate-limiting step in recombination. An important consequence of this is that molecular dynamics simulations seem to give reasonable results for recombination dynamics even when curve crossing is treated by oversimplified models. Finally, it is shown that in order to properly interpret the early time bleach kinetics it is necessary to consider dynamics within the ground state population remaining after excitation as well as excited state dynamics.

41547 Laser photolysis, infrared fluorescence determination of $CH_3(nu_3)$ vibrational deactivation by He, Ar, N_2, CO, SF_6, and $(CH_3)_2CO$. Donaldson, D.J.; Leone, S.R. (Univ. of Colorado, Boulder). *Journal of Physical Chemistry;* **91**: No. 12, 3128-3131(4 Jun 1987).

Room temperature vibrational deactivation rate constants are reported for methyl radicals with antisymmetric stretch excitation, $CH_3(nu_3) + M \rightarrow CH_3 + M$, where M = He, Ar, N_2, CO, SF_6, $(CH_3)_2CO$. Excimer laser photolysis of acetone at 193 nm is used to populate $CH_3(nu_3)$, and time-resolved infrared emission from the CH stretch is used to follow the deactivation kinetics. The rate constants obtained are (+/-2σ) (2.6 +/- 0.5) x 10^{-13} (He, (6.8 +/- 0.7) x 10^{-13} (Ar), (6.1 +/- 0.6) x 10^{-13} (N_2), (3.6 +/- 0.7) x 10^{-13} (CO), (6.9 +/- 0.7) x 10^{-13} (SF_6), and (8.1 +/- 0.9) x 10^{-12} (CH_3COCH_3) in units of cm^3 $molecule^{-1}$ s^{-1}. The deactivation probability is not controlled by long-range forces due to the lone electron on the radical, but rather by the probabilities for intramode vibrational energy flow in CH_3.

4006 Radiation Chemistry

REFER ALSO TO CITATION(S) 40593, 40594, 40595, 41520

41548 (DOE/ER/00038—2992) Production of HO_2 in the radiolysis of water with heavy ions. LaVerne, J.A.; Schuler, R.H. (Notre Dame Univ., IN (USA)). 1987. Contract AC02-76ER00038. 4p. (CONF-870779—2; NDRL—2992). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012748.

From 3. workshop on heavy charged particles in biology and medicine; Darmstadt, F.R. Germany (13 Jul 1987).

Production of HO_2 (hydroperoxy radicals) was investigated using ^1H, ^4He, ^7Li, ^9Be, ^{11}B, ^{12}C, and ^{16}O ions up to 5 MeV/nucleon, and ^{12}C, ^{16}O, and ^{58}Ni ions up to 16 MeV/nucleon and ^{20}Ne ions. HO_2 yield increases with increasing particle charge and can be considerably greater than with fast electrons. Differential HO_2 yield decreases with increasing particle energy. (DLC)

41549 (DOE/ER/00038—3009) University of Notre Dame Radiation Laboratory: Quarterly report, April 1-June 30, 1987. (Notre Dame Univ., IN (USA). Radiation Lab.). 14 Jul 1987. Contract AC02-76ER00038. 43p. (NDRL—3009). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013390.

Sixty-one abstracts are presented of research on the following topics: radiation chemistry, photochemistry, excited states, radicals, carbon-13 hyperfine interactions, electron and energy transfer, relaxation, water, etc. (DLC)

41550 (DOE/ER/00038—3013) Theoretical aspects of heavy-ion tracks in radiation chemistry. Mozumder, A.; LaVerne, J.A. (Notre Dame Univ., IN (USA)). 1987. Contract AC02-76ER00038. 6p. (NDRL—3013; CONF-870701—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012749.

From 8. international congress of radiation research; Edinburgh, UK (19 Jul 1987).

A heavy-ion track in aqueous media consists of a core of high density of energy deposition surrounded by a penumbra traversed by secondary electrons. Initial energy deposited in the electronic form is redistributed by ionized electron and is delocalized within the size of a water molecule. At the end of physical stage the core size may be defined at the radius where the energy transported by secondary electrons exceed that directly produced by the main particle. At the chemical stage, for diffusion kinetic purposes, the core diameter cannot be less than that of a typical spur, taken to be 5 nm. Using Bohr's adiabatic criterion this occurs at 5 MeV/amu above which that criterion gives greater core radius. Track structure depends on the medium; in liquid argon even low-LET electrons produce continuous cylindrical tracks due to extraordinarily large thermalization length.

41551 (EIR—620) Influcence of metallic silver and oxygen on the radiolysis of cesium iodide solutions. Furrer, M.; Gloor, T. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). May 1987. 27p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE87702560.

Silver iodide formation by radiolysis has been studied in the system water/cesium iodide/silver metal. In a number of scenarios for hypothetical core melt accidents, silver iodide has been considered as an effective scavenger for fission product iodine. The influence of dissolved oxygen and the consequences of a variable silver/cesium iodide ratio are shown in detail. Partial kinetic reaction constants for the different parameters are presented and it is shown that they can be simply added together to form an overall reaction rate constant. In a radiation field just short of 0.5 Mrad/h, the influence of oxygen (air) and of the radiation are of the same order of magnitude. The silver/cesium iodide relation is not the relevant parameter in the study of accident scenarios. Instead, a linear correlation is shown between specific metal surface and reaction rates. Data shown here are compatible with earlier measurements made at Oak Ridge National Laboratory.

41552 Investigation of OH-H_2 and OH-CO reactions using argon-sensitized pulse radiolysis. Bera, R.K.; Hanrahan, R.J. (Department of Chemistry, University of Florida, Gainesville, Florida 32611). *Journal of Applied Physics;* **62**: No. 6, 2523-2529(15 Sep 1987).

Gas-phase OH radical reactions with H_2 and CO were studied using pulse radiolysis absorption spectroscopy in Ar-H_2O-H_2 and Ar-H_2O-CO systems. Computer simulation was used to examine the contribution of various reactions involved in OH decay and to confirm the experimentally measured bimolecular rate constants of OH+H_2 and OH+CO reactions. In the hydrogen-argon-water system, it was found that the OH+H reaction makes a substantial contribution to OH decay in competition with the process OH+H_2. The value of the OH+H_2 abstraction rate constant, (3.2 +- 0.7) x 10^{-15} cm^3 $molecules^{-1}$ s^{-1}, obtained empirically from a plot of the pseudo-first-order rate constant for OH consumption versus H_2 pressure was about 50% lower than most literature values, but proved to be acceptable in the dynamic simulations. Although some 30 reactions are needed to describe the Ar-H_2O-CO system, the OH concentration decreases almost exponentially, mostly by the OH+CO addition reaction, with small contributions by other processes. The empirically determined OH+CO bimolecular rate constant of (1.55 +- 0.13) x 10^{-13} cm^3 $molecule^{-1}$ s^{-1} agreed well with literature values determined in the presence of Ar buffer gas and also led to consistent predictions in the computer simulation work.

41553 Halogenated alkylperoxyl radicals as oxidants: effects of solvents and of substituents on rates of electron transfer. Alfassi, Z.B.; Mosseri, S.; Neta, P. (National Bureau of Standards, Gaithersburg, MD). *Journal of Physical Chemistry;* **91**: No. 12, 3383-3385(4 Jun 1987).

The peroxyl radicals CCl_3O_2, $CHCl_2O_2$, CH_2ClO_2, $CCl_3CCl_2O_2$, $CFCl_2O_2$, $CH_3CCl_2O_2$, CF_3CHClO_2, and CBr_3O_2 were produced by pulse radiolysis of aerated solutions of the appropriate halogen compound in 2-propanol or 2-propanol-water solutions. Rate constants for one-electron oxidation of chloropromazine by these radicals were determine by kinetic spectrophotometry in various solvent mixtures. The second-order rate constants were found to vary from 1 x 10^5 to 1 x 10^9 M^{-1} s^{-1}. They depend very strongly on the solvent polarity and a reasonable correlation is obtained between log k for a certain peroxyl radical and the dielectric constant of the solvent mixture. The rate constants in the same solvent are strongly dependent of the substitutents on the methylperoxyl radical and give a good correlation with the polar substitutent constant σ^*.

4007 Radiochemistry And Nuclear Chemistry

REFER ALSO TO CITATION(S) 41008, 41013, 41348, 41350, 41450, 41484, 41502, 41977, 42064, 42375, 42376, 42377

41554 **(CEA-IPSN-INFO—58) Main stage of TMI-2 cleaning.** (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Inst. de Protection et de Surete Nucleaire). Mar 1986. 7p. (In French). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752275.

This report presents the planning of the decontamination undertaken after the accident of TMI-2 from October 1979 to September 1988.

41555 **(JEN—587) Tritium labelling of two new analgesic drugs.** Santamaria, J.; Rebollo, D.V.; Rivera, P.; Esteban, M. (Junta de Energia Nuclear, Madrid (Spain)). 1986. 11p. (In Spanish). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702652.

The labelling with tritium of two arylpropionic esters was studied. The synthesis between ^{3}H-Ibuprofen and the two unlabelled alcoholic moieties (Cl-Alkanol and CF_3-Alkanol) was performed. Assuming that we got ready the acidic moiety, ^{3}H-Ibuprofen, in our Laboratory, we attempted to label with tritium the alcoholic moiety and then go on to its esterification. Prior to labelling, thermic stability of 2-(4-(3-chlorophenyl)-1-piperazinyl) ethanol (Cl-Alkanol) was studied. As result of this study we had to change the labelling method, so that the Cl-Alkanol was unstable at 70°C. Purification was accomplished through thin layer chromatography (TLC) and high performance liquid chromatography (HPLC). Concentration, purity and specific activities of the two labelled compounds were determined by ultraviolet, HPLC and liquid scintillation techniques. 4 references, 17 figures.

41556 **(JEN—588) Tritium labelling of ibuprofen by heterogeneous catalytic exchange.** Santamaria, J.; Rebollo, D.V.; Rivera, P.; Estaban, M. (Junta de Energia Nuclear, Madrid (Spain)). 1986. 10p. (In Spanish). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702653.

The tritium labelling of 2-(4-isobutylphenyl) propionic acid (ibuprofen) was performed. The method employed was heterogeneous catalytic exchange between ibuprofen and tritiated water. Prior to labelling, thermic stability of ibuprofen was studied. Purification was accomplished through thin layer chromatography (TLC) and high performance liquid chromatography (HPLC). Concentration, purity and specific activity of the labelled compound were determined by ultraviolet, HPLC and liquid scintillation techniques. 8 references, 11 figures.

41557 **(NRCN(TN)—092) Biosynthetic preparation of 35-S labelled methionine.** Freud, A.; Hirshfeld, N.; Teitelbaum, Z.; Heimer, Y. (Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev). Nov 1986. 17p. (In Hebrew). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702855.

High specific activity methionine with sulfur-35 was prepared in our laboratory by growing Baker's yeast cells, in a medium containing ^{35}S-sulfate. L-S^{35} methionine was prepared from the acid hydrolyzate of the proteins by chromatography on whatman paper. The specific activity was determined using o-phtaladehyde as a fluorophore to form a fluorescent complex. The specific activity was found to be usually greater than 800 Ci/mmol.

41558 **Multinuclear NMR spectroscopy of the tetrahedral uranium(IV) complex $U(BH_3CH_3)_4$.** Gamp, E.; Shinomoto, R.; Edelstein, N.; McGarvey, B.R. (Lawrence Berkeley Lab., CA). *Inorganic Chemistry;* **26**: No. 13, 2177-2182(1 Jul 1987). Contract AC03-76SF00098.

The temperature dependence of the ^{1}H, ^{11}B, and ^{13}C NMR spectra of T/sub d/ $U(BH_3CH_3)_4$ in solution is reported. The paramagnetic shifts are interpreted as originating purely from spin delocalization mechanisms with no contribution from the metal-orbital dipolar interaction. It is shown that the temperature dependence of both ^{1}H shifts (bridging and terminal protons) is identical with that calculated from a polarization theory which assumes the shift is proportional to the average value of electron spin in the inner 5f orbitals. The proportionality constant is -5.64 MHz for the bridging protons and -0.59 MHz for the terminal protons. The temperature dependences of ^{11}B and ^{13} shifts are found to depart significantly from that predicted by the polarization theory with the largest deviations shown by the ^{11}B shifts. It is shown how those deviations can be accounted for by postulating a second spin delocalization through direct covalency involving molecular orbitals formed from the uranium 5f orbitals and ligand s and p orbitals. 29 references, 4 figures, 3 tables.

41559 **Models for ogranometallic molecule-support complexes. Synthesis and properties of cationic organoactinides.** Lin, Z.; Le Marechal, J.F.; Sabat, M.; Marks, T.J. (Northwestern Univ., Evanston, IL). *Journal of the American Chemical Society;* **109**: No. 13, 4127-4129(24 Jun 1987). Contract FG02-86ER13511.

Chemical and ^{13}C CPMAS NMR data suggest that cationic species play a major role in the surface and possibly catalytic chemistry of actinide alkyls (and by inference, of many other organometallics) on electron-deficient metal oxide supports (e.g., γ-Al_2O_3). Straightforward solution routes to model cationic organoactinide alkyls and complexes free of coordinating bases would be highly desirable, and the authors report here the first efficient synthetic approach as well as initial observations on the properties of the products. Base-coordinated $Cp_2Zr(Me)L^+$ complexes have recently been prepared via a completely different route.

41560 **Reactions of energetic carbon-11 with benzene leading to acetylene.** Lambrecht, R.M.; Furukawa, N.; Wolf, A.P. (Brookhaven National Lab., Upton, NY). *Journal of Physical Chemistry;* **91**: No. 12, 3398-3401(4 Jun 1987). Contract AC02-76CH00016.

The reactions of energetic carbon-11 leading to acetylene were studied in specifically deuteriated benzene and 50/50 mixtures of perdeuteriated and perprotonated benzenes and alkanes. The contributions of intermolecular and intramolecular mechanisms in acetylene formation in benzene were deduced from the relative yields of the three isotopic acetylenes /sup (11)/C_2H_2, /sup (11)/C_2HD, and /sup (11)/C_2D_2. High-energy stripping and abstraction reactions of /sup (11)/C_2 and /sup (11)/C_2H ions appear to account for acetylene formed via an intermolecular pathway. After correction for the intermolecular mechanisms, the remaining acetylene is formed mainly by direct insertion (σ or π) plus a small contribution from a mechanism involving random selection of H or D in the benzene molecule.

41561 **Chemistry of the actinide elements. Vol. 2. 2. Ed .** Katz, J.J.; Morss, L.R.; Seaborg, G.T. (eds.). London, England; Chapman and Hall (1986). 1674p.

Price Pound 110.00.

This is a comprehensive, exposition of the chemistry and related properties of the 5f series of elements: actinium, thorium, protactinium, uranium and the first eleven transuranium elements. The descriptions of each element include accounts of their history, separation, metallurgy, solid-state chemistry, solution chemistry, thermodynamics and kinetics. Additionally, separate chapters on spectroscopy, magnetochemistry, thermodynamics, solids, the metallic state, complex ions and organometallic compounds emphasize the comparative chemistry and unique properties of the actinide series of elements. Comprehensive list of properties of all actinide compounds and ions in solution are given, and there are special sections on such topics as biochemistry, superconductivity, radioisotope safety, and waste management, as well as discussion of the transactinides and future elements.

41562 **Americium.** Schulz, W.W.; Penneman, R.A. (Rockwell International Corp., Richland, WA, USA. Rockwell Hanford Operations; Los Alamos National Lab., NM, USA). pp 887-961 of Chemistry of the actinide elements. Vol. 2. 2. Ed . Katz, J.J.; Morss, L.R.; Seaborg, G.T. (eds.). London, England; Chapman and Hall (1986).

Price Pound 110.00.

The nuclear properties of the americium isotopes are tabulated and methods for their preparation and purification described.

Pyrochemical, precipitation, solvent extraction and ion exchange processes, which have all been used in the separation of americium, are reviewed. Atomic properties are summarized and selected physical properties of the metal are tabulated. Extensive data on the crystal structure of about 150 compounds and alloys is included together with reference to preparation methods. A major section on solution chemistry includes a review of work on oxidation states, electrode potentials, disproportionation, the kinetics of oxidation-reduction reactions, absorption and Raman spectra and the formation of complexes. Formation constants for complexes with inorganic and organic ligands are compiled, and some thermodynamic functions for Am^{3+} complexes are listed.

41563 **Curium.** Eller, P.G.; Penneman, R.A. (Los Alamos National Lab., NM, USA). pp 962-988 of Chemistry of the actinide elements. Vol. 2. 2. Ed . Katz, J.J.; Morss, L.R.; Seaborg, G.T. (eds.). London, England; Chapman and Hall (1986).

Price Pound 110.00.

The nuclear properties of the curium isotopes are tabulated and methods for their preparation and purification summarized. Work on the electronic structure, absorption spectra and the physical properties of the metallic state, is reviewed. Crystallographic data for the metal, its alloys and compounds are tabulated. The formation of simple and complex inorganic and organic compounds is described and a section on solution chemistry deals with complexes which are almost exclusively those of Cm^{3+}. Stability constants for selected Cm^{3+} complexes with inorganic and organic ligands are listed.

41564 **Berkelium.** Hobart, D.E.; Peterson, J.R. (Los Alamos National Lab., NM, USA; Oak Ridge National Lab., TN, USA). pp 989-1024 of Chemistry of the actinide elements. Vol. 2. 2. Ed . Katz, J.J.; Morss, L.R.; Seaborg, G.T. (eds.). London, England; Chapman and Hall (1986).

Price Pound 110.00.

Nuclear properties of the berkelium isotopes are tabulated and methods for their separation and purification summarized. Work on the electronic structure of berkelium, solution and solid state absorption spectra, emission spectra and the physical properties of the metallic state, is reviewed. Theoretical treatments of the electronic structure are touched on. Crystallographic data for the metal and its compounds are tabulated and reference is made to the magnetic behaviour of berkelium ions. In reviewing work on the solution chemistry of berkelium, thermodynamic quantities, stability constants for complexes and redox potentials are compiled.

41565 **Californium.** Haire, R.G. (Oak Ridge National Lab., TN, USA). pp 1025-1070 of Chemistry of the actinide elements. Vol. 2. 2. Ed . Katz, J.J.; Morss, L.R.; Seaborg, G.T. (eds.). London, England; Chapman and Hall (1986).

Price Pound 110.00.

Nuclear data for the californium isotopes are tabulated, and brief reference made to the usefulness of ^{252}Cf as a neutron source. Methods for separating and purifying the isotopes are outlined and summarized schematically. Work on the electronic structure of californium, emission and x-ray spectra, and the physical properties of the metallic state, is reviewed. Compilations of crystallographic data for the metal and its compounds are included. In the section on solution chemistry oxidation-reduction reactions are considered and redox potentials listed; complexation is discussed and stability constants compiled; thermodynamic data, absorption data and solution absorption spectra are given for Cf(111).

41566 **Einsteinium.** Hulet, E.K. (Lawrence Livermore National Lab., CA, USA). pp 1071-1084 of Chemistry of the actinide elements. Vol. 2. 2. Ed . Katz, J.J.; Morss, L.R.; Seaborg, G.T. (eds.). London, England; Chapman and Hall (1986).

Price Pound 110.00.

Nuclear data for the einsteinium isotopes are tabulated and methods for the preparation and purification of the isotopes are summarized. Some atomic properties are also listed. Investigations of the metal and its physical properties are reviewed, though such work is limited by the high specific radioactivity of the element. The few known compounds of einsteinium and the rather sparse information on their properties are listed. The solution chemistry of the trivalent and divalent states is considered and a table of stability constants for Es^{3+} complexes is included.

41567 **Transeinsteinium elements.** Silva, R.J. (Lawrence Livermore National Lab., CA, USA). pp 1085-1120 of Chemistry of the actinide elements. Vol. 2. 2. Ed . Katz, J.J.; Morss, L.R.; Seaborg, G.T. (eds.). London, England; Chapman and Hall (1986).

Price Pound 110.00.

This chapter deals with the elements of atomic number 100 to 109. Selected nuclear properties for the known isotopes are tabulated and the preparation and purification of the isotopes is discussed; the electronic structure of each element is described. Owing to the short half-lives and low production yields, all the available chemical information for these very heavy elements has been obtained from experiments with trace amounts. Some of the established properties of elements 100 to 103, and predicted chemical properties of elements 104-109 are listed. All the experimental and theoretical evidence is now seen to support the earlier prediction that element 103, lawrencium, is the last member of the actinide series. This view is supported by the correlation of the III-II reduction potentials for the actinides and lanthanides.

41568 **Summary and comparative aspects of the actinide elements.** Katz, J.J.; Morss, L.R.; Seaborg, G.T. (Argonne National Lab., IL, USA; California Univ., Berkeley, USA. Dept. of Chemistry; Lawrence Berkeley Lab., CA, USA). pp 1121-1195 of Chemistry of the actinide elements. Vol. 2. 2. Ed . Katz, J.J.; Morss, L.R.; Seaborg, G.T. (eds.). London, England; Chapman and Hall (1986).

Price Pound 110.00.

A unified view of selected aspects of the physical, chemical, and biological properties of the actinide elements is provided. The f-block elements have many unique features, and a comparison of the lanthanide and actinide transition series provides valuable insights into the properties of both. Comparative data are presented on the electronic configurations, oxidation states, redox potentials, thermochemical data, crystal structures, and ionic radii of the actinide elements, together with a miscellany of topics related to their environmental and health aspects. Much of this material is assembled in tabular and graphical form to facilitate rapid access.

41569 **Thermodynamic properties.** Morss, L.R. (Argonne National Lab., IL, USA). pp 1278-1360 of Chemistry of the actinide elements. Vol. 2. 2. Ed . Katz, J.J.; Morss, L.R.; Seaborg, G.T. (eds.). London, England; Chapman and Hall (1986).

Price Pound 110.00.

Measurements of thermodynamic properties for actinide metals, gaseous atoms, aqueous and gaseous ions, oxides and halides are reviewed and assessed. The results are compiled in several tabulations. In particular, a list of all actinide compounds and other species for which measured or estimated thermodynamic properties are available is included.

41570 **Structural chemistry.** Burns, J.H. (Oak Ridge National Lab., TN, USA). pp 1417-1479 of Chemistry of the actinide elements. Vol. 2. 2. Ed . Katz, J.J.; Morss, L.R.; Seaborg, G.T. (eds.). London, England; Chapman and Hall (1986).

Price Pound 110.00.

The structural chemistry of the compounds of the actinide elements from Ac to Es, as investigated mainly by X-ray and neutron diffraction, is reviewed, the treatment being mainly descriptive. Extensive lists of compounds whose structures have been determined are included and ionic and metallic radii are tabulated. A number of structures are illustrated.

41571 **Organoactinide chemistry: properties of compounds having metal-carbon bonds only to π-bonded ligands.** Marks, T.J.; Streitwieser, A. Jr. (Northwestern Univ., Evanston, IL, USA. Dept. of Chemistry; California Univ., Berkeley, USA. Dept. of Chemistry; Lawrence Berkeley Lab., CA, USA). pp 1547-1587 of Chemistry of the actinide elements. Vol. 2. 2. Ed . Katz, J.J.; Morss, L.R.; Seaborg, G.T. (eds.). London, England; Chapman and Hall (1986).

Price Pound 110.00.

Actinide organometallic chemistry involving compounds having metal-carbon linkages only to π-bonded ligands is summarized. The compounds dealt with are allyl complexes, cyclopentadienyl complexes, modified cyclopentadienyl ligand complexes, pentadienyl compounds, arene complexes and cyclo-octatetraene complexes. The synthesis of the compounds is outlined and the molecular structures of some are illustrated. Characteristics of the structure and bonding are discussed. Thermodynamic data for the formation of some actinide carboxylate complexes are listed.

41572 **Future elements (including superheavy elements).** Seaborg, G.T.; Keller, O.L. Jr. (California Univ., Berkeley, USA. Dept. of Chemistry; Lawrence Berkeley Lab., CA, USA; Oak Ridge National Lab., TN, USA). pp 1629-1646 of Chemistry of the actinide elements. Vol. 2. 2. Ed . Katz, J.J.; Morss, L.R.; Seaborg, G.T. (eds.). London, England; Chapman and Hall (1986).

Price Pound 110.00.

The heaviest known element has atomic number 109. Despite ever decreasing half lives and yields in the upper region of known elements, theoretical predictions define a range of superheavy elements (atomic numbers 108-120) with sufficient stability and yield to allow their study, if they could be synthesized. The calculated electronic structures of these elements are summarized and illustrated in a modified periodic table showing known and predicted electron shells. Predictions have been made of the chemical properties and these are reviewed and tabulated. A striking feature of the predictions is a sudden decrease in boiling point going from element 113 to 114. This is attributable to relativistic effects. Comparison is made with chemical homologs of lower atomic number. Unsuccessful attempts to synthesize and identify superheavy elements through the bombardment of heavy target nuclei with heavy ions are outlined.

4008 Combustion, Pyrolysis, And High-temperature Chemistry

41573 **(CONF-8610210—2) Analytical prediction of combustion performance characteristics of bipropellant liquid rocket engine combustor.** Chiu, H.H.; Jiang, T.L.; Berry, G.F.; Croke, E.J. (Illinois Univ., Chicago (USA); Argonne National Lab., IL (USA)). Oct 1986. Contract W-31109-ENG-38. 11p. NTIS, PC A02. File Number DE87011355.

From 23. joint Army Navy NASA Air Force combustion meeting (JANNAF); Hampton, VA, USA (20 Oct 1986).

Theories of conjugate and group combustion and the associated numerical code are developed to aid in the analytical prediction of combustion performance and to establish the theoretical base of engine efficiency optimization by the technique of optimum-size-droplet (OSD) sprays. The numerical simulation and performance synthesis of a cylindrical combustor with a pair of concentric annular ring injectors for fuel and oxidizer reveals the existence of: (1) a pronounced efficiency peak in a droplet size region termed "mixing and vaporization controlled group conjugate and normal combustion region" (MVGCN); and (2) an asymptotic efficiency plateau broadly based in a fine-spray region termed "Priem-Heidmann vaporization controlled combustion region" (PHVC). The mechanisms and the generic characteristics of enhanced efficiency in MVGCN peak and PHVC plateau are identified, and the criteria for design of the optimum injector and injector assembly, together with reduction of combustor size, based on the combustion efficiency profile are discussed. The conventional design concept linked with the corollary "the finer the spray, the better the efficiency" is reassessed in light of the present theoretical predictions. Areas for future research are also discussed.

41574 **(SAND—87-0095C) Measurements of gas velocities and temperatures in a large open pool fire.** Schneider, M.E.; Kent, L.A. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 44p. (CONF-870816—6). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87005853.

From 24. national heat transfer conference and exhibition; Pittsburgh, PA, USA (9 Aug 1987).

There is an interest in determining the response and survivability of a variety of items subject to engulfment in a large fire which may occur in a transportation accident. In order to estimate this response, knowledge of the thermal and flow conditions prevailing in these pool fires is required. A total of ~48,500 liters of JP-4 fuel was burned in a 9 x 18 meter pool, producing peak temperatures in excess of 1230°C (2250°F), over much of the instrumented region of the flame. As is often the case in fires of this size, the effects of mild ambient winds on the measurements were pronounced. Attempts have been made to mitigate these effects by the application of conditional sampling. Temperatures are compared with measurements made in other large aviation fuel fires. The measured velocities are slightly less than would be predicted from an empirical model that was developed from experimental results for methane diffusion flames that are orders of magnitude smaller.

41575 **Mechanism and modeling of nitrogen chemistry in flames.** Miller, J.A. (Sandia National Labs., Livermore, CA). pp 275-276 of Proceedings of the symposia of the division of environmental chemistry of the American Chemical Society. Washington, DC; American Chemical Society (1987). (CONF-870410—).

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

Nitric oxide formation under lean combustion is well understood and can be predicted accurately by the Zel'dovich, or thermal, NO mechanism. However, complications arise under rich conditions and when nitrogen is chemically bound in the fuel. These situations have in common the feature that hydrogen cyanide is formed as a principal intermediate, either from the Fenimore reaction CH + N/sub 2/→HCN+N or from pyrolysis of a complicated fuel molecule. This paper focuses on current understanding and on the modeling of this HCN-centered chemistry. Using BAC-MP4 (bond-additivity-corrected fourth-order Moller-Plesset perturbation theory) potential parameters. The author has subjected these reactions to detailed statistical-theoretical analyses. The author discusses how the theoretical results compare with experiment and how they influence the model development.

41576 **The structure of cyanogen-nitrogen dioxide premixed flames.** Smith, O.I.; Thorne, L.R. Northridge, CA; Combustion Institute (1986). 27p. (CONF-8610180—). Combustion Institute, Western States Sect., c/o L.S. Caretto, Calif. State Univ., Northridge, CA 91330.

From Fall meeting of the Western States Section/Combustion Institute; Tucson, AZ, USA (27 Oct 1986).

Technical Paper WSS/CI 86-34.

This paper presents the results for two cyanogen - nitrogen dioxide flames. The most striking feature of these flames is their intense visible emission and large heat release. CN, major stable species and temperature profiles have been measured and are compared to the results of flame structure calculations in order to develop a combustion mechanism. The richer of the two flames studied is more stable than the leaner flame. This is because oxygen atoms in the leaner flame react with NO/sub 2/ to give NO and O/sub 2/, thereby depleting the "reactive" free radical pool. In the richer flame, the major route for NO/sub 2/ loss is thermal decomposition to give NO+O. This adds oxygen atoms to the "reactive" radical pool and stabilizes the flame. The major loss mechanisms for CN in these flames led to the formation of NCO which is depleted primarily by reacting with NO and disproportionation. Both reactions serve to stabilize the flame, the former reaction releases a substantial amount of heat and the second is a major channel for N production. The largest differences between the observed and calculated profiles occur for NO far down stream and CN in the richer flame. These discrepancies are probably due to the lack of additional sink reactions for C and CN in the model.

42 ENGINEERING

41577 (CONF-870544—4) A rationale for construction inspection. Beatty, R.A. (Argonne National Lab., IL (USA)). 4 May 1987. Contract W-31109-ENG-38. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012217.

From 41. annual quality conference; Minneapolis, MN, USA (4 May 1987).

Construction management efficiency and effectiveness can receive an immediate boost by the application of time tested planning techniques used by successful managers. The three step method involves identifying requirements, setting priorities, and allocating resources to ensure that the critical items and activities receive appropriate attention. This discussion addresses a rationale that integrates these three aspects of construction project management. Savings that result far exceed the cost of additional training and orientation. Applying this approach achieves immediate benefits including: concentrate effort on the activities most important to meeting requirements; ensure that products and services conform with the requirements; make positive impressions on sponsor, customer, employees, and contractors; and switch emphasis to prevention from inspection.

41578 (CONF-870742—2) Vibrational control of nonlinear parabolic systems. Bentsman, J.; Meerkov, S.M.; Shu, Xianshu. (Illinois Univ., Urbana (USA). Dept. of Mechanical and Industrial Engineering; Michigan Univ., Ann Arbor (USA). Dept. of Electrical Engineering and Computer Science; Illinois Inst. of Tech., Chicago (USA). Dept. of Electrical and Computer Engineering). 1987. Contract FG02-85ER13315. 5p. NTIS, PC A02. File Number DE87011171.

From 10. IFAC world congress on automatic control; Munich, F.R. Germany (27 Jul 1987).

Vibrational control is a non-classical control principle which proposes utilization of zero mean parametric excitation of a dynamical system to achieve control objectives. The present paper is devoted to the development of vibrational control theory of nonlinear infinite dimensional systems described by parabolic partial differential equations (PDE's). Conditions of vibrational stabilizability of nonlinear parabolic PDE's by linear multiplicative vibrations are given. An example of vibrational stabilization of unstable PDE's is presented.

41579 (SAND—87-0006C) The effect of chamber pressure on particle velocities in low-pressure plasma spray deposition. Smith, M.F.; Dykhuizen, R.C. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 10p. (CONF-870985—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010686.

From National thermal spray conference; Orlando, FL, USA (14 Sep 1987).

A laser velocimeter has been used to measure spray particle velocities in a low-pressure plasma spray system at chamber pressures ranging from 6.7 to 80 kPa (50 to 600 Torr). For Al_2O_3 spray powder with a mean diameter of 44 μm, peak particle velocities were on the order of 200 to 400 m/s. The measured velocity distributions were strongly dependent upon spray chamber pressure, with the highest particle velocities at intermediate pressures of -40 kPa (300 Torr). Particle velocities predicted with a simple analytical model are in reasonable agreement with experimental results close to the spray gun, where drag due to chamber gases can be neglected. This simple model also correctly predicts a particle velocity maximum at 45 kPa (340 Torr).

41580 (SAND—87-0850C) Metal surface gouging by hypervelocity sliding contact. Barker, L.M.; Trucano, T.G.; Munford, J.W. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 5p. (CONF-870753—26). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012371.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

Surface gouging due to hypervelocity sliding contact occurs above certain threshold velocities in hypervelocity gun barrels and on the rails of rocket-propelled sleds. A theory for the mechanism of gouging damage is tested by computer simulation of the dynamic gouge initiation and growth phases. In addition to agreeing with the observations, parameter variations indicated design concepts which result in gouge-mitigating shoes for rocket sleds.

41581 (UCID—19080-84/85) Engineering Research Division publication report, calendar year 1984 and 1985. Holten, M.L.; King, Y.T. (comps.). (Lawrence Livermore National Lab., CA (USA)). Jun 1987. Contract W-7405-ENG-48. 64p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87011918.

This report lists all formal publications produced by the division during the calendar year 1984 and 1985. (JDB)

4202 Facilities And Equipment

REFER ALSO TO CITATION(S) 40494, 40504, 40658, 40659, 40884, 40925, 40955, 40978, 41063, 41330, 41342, 41641, 41651, 41687, 41688, 41695, 41732, 41735, 41740, 42715, 42800, 42876

41582 (AD-A—180341/0/XAB) Research on cryogenic vacuum tunneling. Final report, 1 August 1984-31 January 1987. Quate, C.F. (Stanford Univ., CA (USA). Edward L. Ginzton Lab.). Apr 1987. 7p. (GL—4194). NTIS MF A01.

Availability: Microfiche copies only.

The scanning tunneling microscope (STM) was designed and constructed to operate at low temperature. In liquid helium at 4°K the spatial variation of the superconducting energy gap was mapped. It, also, was used for the first time to record the vibrational spectra of a molecule adsorbed on graphite and to image the molecule itself. The STM has also been used to record the phonon spectra of the graphite substrate. This is a new tool for low-temperature studies that enables study of the spatial variations in structure and spectra.

41583 (AD-A—180555/5/XAB) Evaluation of heat-strain-monitoring methods for workers in encapsulating, impermeable protective clothing. Final report. Eley, W.D. (Coast Guard, Washington, DC (USA). Office of Research and Development). May 1987. 65p. (USCG-D—12-87). NTIS, PC A04/MF A01.

Heat strain for six young, healthy, acclimized men (mean age 26.2 yrs., weight 84.1 kg) was measured during moderate exercise at various ambient conditions (21.5 C, 28 C, 31.5 C with sunshine) while wearing fully encapsulating chemical protective suits with self-contained breathing apparatus. The total weight of the Coast Guard Chemical Response Suit was 26.3 kg. The subjects performed a total of 35 minutes (20 minutes exercise, as determined by V(O2) measurements was 383 kcal/hr. Heart rate and mean skin temperature rose significantly as ambient temperature increased. Under the most adverse ambient condition (31.5 C with sunshine), the mean heart rate and skin temperature were elevated 39.6 bpm and 4.1 C, respectively, over those recorded for control conditions. Significant increases in rectal temperature were not noted. A mean difference in weight loss was only observed with significance between control conditions and the most severe ambient environment. The five-minute recovery heart rate, recorded at minute 25 after 20 minutes of exercise, increased significantly as ambient temperature conditions became more adverse. It is concluded that wearers of impermeable protective clothing show progressive increases in heat strain as ambient temperature increases. This study indicates that recovery heart rate is probably the best indicator of heat tolerance endpoints for work in encapsulating, impermeable protective clothing.

41584 (BDX—613-3754) Evaluation of coated carbide drill bits for drilling of printed wiring board materials: Final report. Pemberton, S.E. (Allied Corp., Kansas City, MO (USA). Bendix Kansas City Div.). Jun 1987. Contract AC04-76DP00613. 40p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011005.

Three carbide drill bits were evaluated to determine which ones produced the best hole quality in four types of copper-resin laminates. Titanium-nitride-coated and polycrystalline-diamond-tipped bits were compared with the carbide drill bits currently in

use. The number of hits in epoxy-glass, polyimide-glass, polyimide-quartz, and polyimide-Kevlar were recorded. the diamond-tipped bit excelled in hole quality and longevity in all four materials; but considering the frequent necessity for changing drills, titanium-nitride-coated drills may be an effective compromise between cost and quality.

41585 **(CONF-870620—6) Effects of fin pattern on the air side heat transfer coefficient in plate finned tube heat exchangers.** Beecher, D.T.; Fagan, T.J. (Westinghouse Research and Development Center, Pittsburgh, PA (USA)). Jun 1987. Contract AC05-84OR21400. 29p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87010908.

From American Society of Heating, Refrigerating and Air-Conditioning Engineers meeting; Nashville, TN, USA (28 Jun 1987).

The effects of air velocity, heat exchanger geometry and fin pattern on air side heat transfer in plate finned tube heat exchangers were investigated experimentally using a single fin passage model. The geometric parameters considered included tube diameter, transverse tube spacing, longitudinal tube spacing, number of tube rows and fin spacing. The effects of fin pattern depth and number of fin patterns per longitudinal tube row were investigated for a pattern consisting of corrugations of triangular cross section transverse to the direction of air flow. The heat transfer data were correlated in terms of the dimensionless heat transfer coefficient (Nussult number) based on the arithmetic mean temperature difference Nu/sub a/ and the Graetz number Gz, a dimensionless measure of the level of flow development.

41586 **(CONF-870679—2) Experiments in autonomous robotics.** Hamel, W.R. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 7p. (CESAR—87/21). NTIS, PC A02/MF A01; GPO Dep. File Number DE87010893.

From 5. symposium on energy engineering sciences; Argonne, IL, USA (17 Jun 1987).

The Center for Engineering Systems Advanced Research (CESAR) is performing basic research in autonomous robotics for energy-related applications in hazardous environments. The CESAR research agenda includes a strong experimental component to assure practical evaluation of new concepts and theories. An evolutionary sequence of mobile research robots has been planned to support research in robot navigation, world sensing, and object manipulation. A number of experiments have been performed in studying robot navigation and path planning with planar sonar sensing. Future experiments will address more complex tasks involving three-dimensional sensing, dexterous manipulation, and human-scale operations.

41587 **(CONF-870914—1) Analysis of air-conditioning controls for Building 4500 South.** Hamblen, S.E. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009828.

From 10. world energy engineering congress; Atlanta, GA, USA (29 Sep 1987).

Reports of unstable zone temperatures throughout building 4500 South at the Oak Ridge National Laboratory (ORNL), Oak Ridge, Tennessee, resulted in a study of the control systems of the four main air-conditioning units that service the building. The purpose of this study was to determine the source of the problem and to make recommendations for correcting the situation. The four units included in the study were designated as AC-1, AC-2, AC-3, and T-18. All four units are 100% outdoor air heating and cooling units with airflows of 115,000 CFM, 103,000 CFM, 67,000 CFM, and 146,000 CFM, respectively.

41588 **(CONF-8704161—1) Traction-drive seven degrees-of-freedom telerobot arm: A concept for manipulation in space.** Kuban, D.P.; Williams, D.M. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010895.

From 21. aerospace mechanisms symposium; Houston, TX, USA (29 Apr 1987).

As man seeks to expand his dominion into new environments, the demand increases for machines that perform useful functions in remote locations. This new concept for manipulation in space is based on knowledge and experience gained from manipulator systems developed to meet the needs of remote nuclear applications. It merges the best characteristics of teleoperation and robotic technologies. This paper summarizes the report of a study performed for NASA Langley Research Center. The design goals for the telerobot, a mechanical description, and technology areas that must be addressed for successful implementation will be presented and discussed. The concept incorporates mechanical traction drives, redundant kinematics, and modular arm subelements to provide a backlash-free manipulator capable of obstacle avoidance. Further development of this arm is in progress at the Oak Ridge National Laboratory.

41589 **(CONF-8706125—9) Design and testing of electrical insulation for superconducting coils.** Schwenterly, S.W. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 11p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87012256.

From Conference on advances in cryogenic engineering; St. Charles, IL, USA (14 Jun 1987).

This paper reviews and summarizes the dielectric properties of liquid and gaseous helium and nitrogen, vacuum, and solid insulation materials for practical insulation design for superconducting coils. The influence of electrode geometry on breakdown voltage is discussed, and features that require special care are pointed out. Appropriate room-temperature high-voltage testing is considered. Finally, the paper examines the implications for coil insulation design of a new class of superconductors that can operate at temperatures approaching 77 K.

41590 **(DOE/ER/45025—17) Superconducting metallic superlattices.** Falco, C.M.; Vaglio, R.; Cucolo, A.M. (Arizona Research Labs., Tucson (USA); Salerno Univ. (Italy). Dipartimento di Fisica). 1987. Contract AC02-83ER45025. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87012742.

Since the coherence length is of order 50 A to 1 μm, it is possible to alternately layer thin films of a superconductor with another material to affect the physical properties of the resulting superlattice. A brief description of our sputtering technique used to prepare superlattices consisting of Nb/Cu and Ta/Mo is given. Optical interferometry, x-ray diffraction and ion beam analysis techniques independently confirm that control of +-0.3% is achieved over the amount of material deposited in each layer. Results of a study of Josephson tunneling to Nb/Cu metallic superlattices are reviewed. These measurements enable a determination of the London penetration depth to be made as a function of superlattice layer thickness.

41591 **(DP—1750) Glove box design, procurement and installation guide: Savannah River Plant.** (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). Apr 1987. Contract AC09-76SR00001. 372p. NTIS, PC A16/MF A01; 1; GPO Dep. File Number DE87013054.

This is an information package to assist the design, procurement and installation of both shielded and unshielded glove boxes for the Savannah River Plant. The information presented includes specific proven design details, technical specifications, procurement information, design logic, cost data, safety requirements, references and installation information. All of the information contained in this guide has undergone an approval procedure that has included general acceptance by both the Engineering Department and the Savannah River Plant. Although there may be situations when this data will not apply and cannot easily be adapted, they should be considered the primary design basis and followed, to promote standard cost effective designs for the Savannah River Plant.

41592 **(DP-MS—87-39) Part cleanliness determined by gas transfer.** Clark, T.D. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). 1987. Contract AC09-76SR00001. 5p. (CONF-8704144—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010200.

From IMOG subgroup on cleaning meeting; Oak Ridge, TN, USA (22 Apr 1987).

It is important to ensure that rebuilt parts do not contain any foreign material that could affect their function when put in operation. The system used at SRP (Savannah River Plant) to confirm the "cleanliness" of these parts is the topic of this paper.

41593 **(EFI—749(76)-85) Continuous action adsorption cryogenic refrigerator without movable units.** Aroyan, A.A.; Arutyunyan, M.A.; Mina, R.T. (Erevanskij Fizicheskij Inst. (USSR)). 1985. 20p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702672.

An adsorption cryogenic refrigerator of continuous action without units is constructed. An object to be cooled is to placed into the common evaporation zone of two thermosiphons. The refrigerator cooling amounts to — 5 mW at T — 0.6 K and — 30 mW at T — 1 K. 12 references, 7 figures.

41594 (EPRI-AP—5190, pp 5.1-5.39) **Reliability, availability, and maintainability of airline gas turbine engines.** Nowlan, F.S. May 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920429.

In Gas turbine procurement and combined-cycle repowering: 1986 workshop: Final report.

Gas turbine engines in airline service have achieved very high levels of safety, operating reliability, and availability, together with quite modest maintenance costs. Some of these characteristics and processes that led to their achievement are described. The airline environment is very different from that of the utility industry. For one thing, nearly all engine maintenance is performed off-line at a major shop facility. This influences maintainability and availability considerations. Again, a given type of engine and its derivatives are produced over a period of many years. The resulting large populations give impetus to reliability-improvement programs. Another major difference is that the attention of airline operators is focused on the performance characteristics of the engine's host vehicle, the airplane itself. Such characteristics include payload-range capability, speed, runway-length requirements, noise, and direct operating costs. These in turn are functions of such engine characteristics as thrust rating, thrust/weight ratios, specific fuel consumption, and so on. This affects engine selection decisions.

41595 **(JAERI-M—86-180) Exact solution of the inverse problem for a six-link manipulator with a mechanical offset.** Sasaki, S.; Nabeshima, K. (Japan Atomic Energy Research Inst., Tokyo). Dec 1986. 70p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87702646.

In this paper, an algebraic approach to derive a joint solution for a six-link manipulator with a mechanical offset is proposed. Generally, derivation of exact joint solutions for such a multi-link manipulator is considered to be an extremely cumbersome problem and a practical approach might be limited to numerical approximation based on linearization and iteration. Compared with such a conventional method, the polynomial expression presented in this paper permits to determine all feasible solutions of the inverse kinematics of the manipulator. An algorithm of the solution for a six-link manipulator was implemented in the computer code ARM3. Joint behaviors with the mechanical offset were obtained with sufficient accuracies.

41596 **(KFK—4195) Experimental modal survey of a horizontal cylindrical shell partly filled with water.** Eberle, F.; Kadlec, J.; Hailfinger, G.; Scharnowell, R. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Nukleare Sicherheit). Feb 1987. 64p. NTIS, PC E09; Available from NTIS as TIB/B87-07809.

The report deals with theoretical and experimental modal surveys of a horizontally located cylindrical shell, requested for experimental verification of the SING-S coupled fluid/structure-interaction computer program. The eigenfrequencies, the mode shapes and the critical damping ratios of the test cylinder used (diameter 1000 x 3 x 1600 mm, empty or partly filled with water, water level 680 mm) were extracted from the set of simultaneously measured relaxation response signals. The transient response was achieved via a snapback-process or an impulse excitation of the test cylinder shell. The EVA computer program was used to extract the modal characteristics from the acceleration response signals. A total number of 57 eigenmodes were identified experimentally - 33 eigenmodes of the test cylinder partly filled with water and 24 eigenmodes of the empty test cylinder.

41597 **(LA-UR—86-145) Membrane heat pipe development for space radiator applications.** Woloshun, K.; Merrigan, M. (Los Alamos National Lab., NM (USA)). 1986. Contract W-7405-ENG-36. 7p. (CONF-860102—17). NTIS, PC A02/MF A01; GPO Dep. File Number DE86006015.

From 3. symposium on space nuclear power systems; Albuquerque, NM, USA (13 Jan 1986).

A self-deploying membrane heat pipe (SMHP) is being designed and fabricated to operate in an in-cabin experiment aboard a STS flight. The heat pipe comprises a mylar membrane with a woven fabric arterial wick and R-11 as the working fluid. Preliminary results indicate that this SMHP design will successfully expand and retract in response to an applied heat load; the retraction force is provided by a constant force spring.

41598 **(LA-UR—87-2251) Numerical predictions of EML [electromagnetic launcher] system performance.** Schnurr, N.M.; Kerrisk, J.F.; Davidson, R.F. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 18p. (CONF-8709109—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011727.

From 5. US Army symposium on gun dynamics; Rensselaerville, NY, USA (23 Sep 1987).

The performance of an electromagnetic launcher (EML) depends on a large number of parameters, including the characteristics of the power supply, rail geometry, rail and insulator material properties, injection velocity, and projectile mass. EML system performance is frequently limited by structural or thermal effects in the launcher (railgun). A series of computer codes has been developed at the Los Alamos National Laboratory to predict EML system performance and to determine the structural and thermal constraints on barrel design. These codes include FLD, a two-dimensional electrostatic code used to calculate the high-frequency inductance gradient and surface current density distribution for the rails; TOPAZRG, a two-dimensional finite-element code that simultaneously analyzes thermal and electromagnetic diffusion in the rails; and LARGE, a code that predicts the performance of the entire EML system. Trhe NIKE2D code, developed at the Lawrence Livermore National Laboratory, is used to perform structural analyses of the rails. These codes have been instrumental in the design of the Lethality Test System (LTS) at Los Alamos, which has an ultimate goal of accelerating a 30-g projectile to a velocity of 15 km/s. The capabilities of the individual codes and the coupling of these codes to perform a comprehensive analysis is discussed in relation to the LTS design. Numerical predictions are compared with experimental data and presented for the LTS prototype tests.

41599 **(ORNL/TM—10397) Dynamic task allocation for a man-machine symbiotic system.** Parker, L.E.; Pin, F.G. (Oak Ridge National Lab., TN (USA)). Jun 1987. Contract AC05-84OR21400. 55p. (CESAR—87/08). NTIS, PC A04/MF A01; GPO Dep. File Number DE87011950.

This report presents a methodological approach to the dynamic allocation of tasks in a man-machine symbiotic system in the context of dexterous manipulation and teleoperation. This report addresses a symbiotic system containing two symbiotic partners which work toward controlling a single manipulator arm for the execution of a series of sequential manipulation tasks. It is proposed that an automated task allocator use knowledge about the constraints/criteria of the problem, the available resources, the tasks to be performed, and the environment to dynamically allocate task recommendations for the man and the machine. The presentation of the methodology includes discussions concerning the interaction of the knowledge areas, the flow of control, the necessary communication links, and the replanning of the task allocation. Examples of task allocation are presented to illustrate the results of this methodology.

41600 **(PB—87-184214/XAB) NIOSH (National Institute for Occupational Safety and Health) certified equipment list as of October 1, 1986.** (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Oct 1986. 422p. (DHHS/PUB/NIOSH—87-102). NTIS, PC A18/MF A01.

See also PB—83-182154.

The publication contains a listing of personal protective devices and reliable industrial hazard measuring instruments that have been evaluated by NIOSH and found acceptable for use as of October 1, 1986. Certified coal-mine-dust personal-sampler units are listed along with the names and addresses of manufacturers and distributors. Data are provided on the effectiveness and use of self-contained breathing apparatus. Gas masks for protection against acid gases, organic vapors, ammonia, chlorine, sulfur-dioxide, carbon-monoxide, pesticides, and other gases and vapors are discussed. Supplied air respirators are discussed, including Type-C continuous flow, Type-C pressure demand, Type-C demand, Type CE continuous-flow abrasive blasting, Type-A, and Type-B. Particular respirators described include those for single use, for dust and mists, for dusts, fumes and mists, and for high-efficiency usage. Chemical cartridges used to prevent exposure to ammonia, methylamine, chlorine, hydrogen chloride, sulfur dioxide, organic vapors, paints, lacquers and enamels, pesticides, vinyl chloride, and other gases and vapors are described. Powered air purifiers are discussed. Also included are the NIOSH policy statement on approval of air-purifying respirators with end-of-service-life indicators, the NIOSH policy statement on use of respirators for protection against asbestos, and the NIOSH and OSHA testing and certification of positive-pressure closed-circuit self-contained breathing apparatus.

41601 **(POEF-T—3453) Studies on the problem of three-quarter inch cylinder valve bonnet nut seizure/thread deformation.** Fout, S.L.; Wamsley, S.D. (Martin Marietta Energy Systems, Inc., Portsmouth, OH (USA). Quality and Technical Services Div.). 10 Jun 1987. Contract AC05-76OR00001. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012057.

Due to a recent increase in three-quarter inch cylinder valve changeouts as a result of deformed bonnet threads, a project was initiated to study the problem and determine ways of improving the service life of the valves by recutting the threads after deformation. Valve bodies and assemblies were acquired from Stores, assembled, and the bonnet nuts were torqued to 110 ft-lb (the maximum allowable torque limit) repeatedly to cause bonnet thread deformation. The cycles to deformation requiring repair were recorded. It was found that the valves from lot number 8204 achieved bonnet thread deformation within 7, 110 ft-lb cycles. In contrast, valves from lot number 7908 took 50 cycles at 110 ft-lb without deformation before testing was discontinued. Measurements of valves from each lot number by the Gauge Laboratory showed that the bonnet threads of valves from lot number 8204 failed the Go/No-Go gauges and had major diameters greater than the thread specification allows. At least three factors must be considered for preventing premature valve failures. It appears that if the bonnet threads of three-quarter inch valves meet specification, sufficient bonnet thread damage is absent, and the torque used on the bonnet nut is kept at or below 110 ft-lb, the three-quarter inch valves can be expected to give an adequate service life.

41602 **(RFP—4004) Application of a dimensional artifact to verify permanent-control programs of computer controlled coordinate measuring machines.** Schweitzer, T.F.; Deitesfeld, C.A. (ed.). (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 3 May 1987. Contract AC04-76DP03533. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012302.

The introduction of computer controlled coordinate measuring machines (CMM) created a concern for the Dimensional Metrology Laboratory at the Rocky Flats Plant, Golden, Colorado. The permanent-control program software of these machines required verification. Until the software was verified, it had to be assumed that the convergence of the modeling algorithms established by the manufacturer were acceptable. This report documents research for developing a method to verify the permanent-control programs of computer controlled CMMs.

41603 **(SAND—86-0487C) Measurement of inflight base pressure on an artillery-fired projectile.** (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 16p. (CONF-870830—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87004519.

From AIAA aerodynamics flight mechanics conference; Monterey, CA, USA (17 Aug 1987).

A capability of measuring in-flight base pressure on an artillery-fired projectile has been developed. A key part of this development was the design and development of an environment-driven projectile base-sealing mechanism that protects the sensitive in-flight base pressure instrumentation during gun chamber and tube exit. Base pressure was measured on two 155-mm projectile configurations of current interest, and the flight data compare well with ground-base measurements and computations for the same or similar configurations. The most significant comparison between flight test data and those obtained in the wind tunnel naturally lies with those from models of the actual projectiles. A comparison using the data in drag coefficient form shows that the flight test base pressure was higher subsonically, lower transonically, and slightly lower supersonically. The primary cause of differences in base pressure is probably the model support interference effects. Also, spin effects in flight test might contribute - especially transonically and subsonically - because of "excess-spin" effects.

41604 **(SAND—86-2923C) A passive means for eliminating range loss for projectiles with partially restrained internal members.** Hodapp, A.E. Jr. (Sandia National Labs., Albuquerque, NM (USA)). Nov 1986. Contract AC04-76DP00789. 20p. (CONF-870830—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87004241.

From AIAA aerodynamics flight mechanics conference; Monterey, CA, USA (17 Aug 1987).

A theory is developed to investigate offsetting the center of gravity (cg) of a Partially Restrained Internal Member (PRIM) from the projectile spin axis to provide a passive means for eliminating the PRIM induced instabilities that sometimes cause large losses in range and deflection. Results for cylindrical PRIM geometries indicated that, except for large diameter thin PRIM shapes, small PRIM cg offsets, including some that occur randomly within manufacturing tolerances, should be sufficient to reduce the instability induced range and deflection losses to acceptable levels. Experimental results are presented to confirm the stabilizing effect of PRIM cg offset.

41605 **(SAND—87-0031C) Maximum terminal velocity turns at constant altitude.** Eisler, G.R.; Hull, D.G. (Sandia National Labs., Albuquerque, NM (USA); Texas Univ., Austin (USA)). 1987. Contract AC04-76DP00789. 21p. (CONF-870830—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87005061.

From AIAA aerodynamics flight mechanics conference; Monterey, CA, USA (17 Aug 1987).

An optimal control problem is formulated for a maneuvering reentry vehicle to execute a maximum terminal velocity turn at constant altitude to a fixed final position. A control solution technique is devised which uses a Newton scheme to repetitively solve a nonlinear algebraic system for two paramcters to provide the on-line guidance. The turn control takes advantage of the high dynamic pressure at the beginning of the flight path; the lift solution acts to null deviations from the prescribed altitude. Control solutions are compared for a continuously updated, approximate physical model, for a simulation of the approximate optimal guidance in a true physical model, and for a parameter optimization solution for the true model. End constraint satisfaction is excellent. Overall trajectory agreement is good, if the assumed atmospheric model is reasonably accurate.

41606 **(SAND—87-1511C) A mobile robot primitive command language.** Steele, J.P.H.; Starr, G.P.; Akins, J.L. (Sandia National Labs., Albuquerque, NM (USA); New Mexico Univ., Albuquerque (USA). Dept. of Mechanical Engineering). 1987. Contract AC04-76DP00789. 5p. (CONF-870896—1). NTIS, PC A02. File Number DE87011316.

From Workshop on languages for automation; Vienna, Austria (24 Aug 1987).

This paper presents a set of primitive robot commands which are appropriate for point to point control of a mobile robot. In addition, the software architecture, the message passing protocol, and a higher level command syntax are discussed.

41607 **(SAND—87-1648C) Parachute systems technology: Fundamentals, concepts, and applications: Advanced parachute design.** Peterson, C.W.; Johnson, D.W. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 23p. (CONF-8706165—1). NTIS, PC A02. File Number DE87011634.

From Parachute systems technology: fundamentals, concepts, and applications; Munich, F.R. Germany (22 Jun 1987).

Advances in high-performance parachute systems and the technologies needed to design them are presented in this paper. New parachute design and performance prediction codes are being developed to assist the designer in meeting parachute system performance requirements after a minimum number of flight tests. The status of advanced design codes under development at Sandia National Laboratories is summarized. An integral part of parachute performance prediction is the rational use of existing test data. The development of a data base for parachute design has been initiated to illustrate the effects of inflated diameter, geometric porosity, reefing line length, suspension line length, number of gores, and number of ribbons on parachute drag. Examples of advancements in parachute materials are presented, and recent problems with Mil-Spec broadgoods are reviewed. Finally, recent parachute systems tested at Sandia are summarized to illustrate new uses of old parachutes, new parachute configurations, and underwater recovery of payloads.

41608 **(SAND—87-1649C) Parachute systems technology: Fundamentals, concepts, and applications.** Johnson, D.W. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 10p. (CONF-8706165—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011722.

From Parachute systems technology: fundamentals, concepts, and applications; Munich, F.R. Germany (22 Jun 1987).

In this paper, many different types of tests, vehicles, and data acquisition systems will be discussed. The types of tests used by parachute designers are only limited by the designers' imaginations. Since the paper is of finite length, some designers' favorite methods of accomplishing a certain objective will not be discussed. Any omissions are unintentional and are left to future discussions either formally or informally.

41609 **(SAND—87-8222) Characterization of a platinum silicide focal plane array.** Barry, D.J. (Sandia National Labs., Livermore, CA (USA)). Jul 1987. Contract AC04-76DR00789. 50p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87012999.

This report discusses the characterization techniques for an infrared camera system. To save time taking data and to increase the repeatability of the measurements, a computer took all the data and did almost all of the calculations. Traditionally, MRT (minimum resolvable temperature) is found using human observers, but this paper introduces an automated MRT algorithm to replace the traditional method.

41610 **(TVA/OP/EDT—86/38) Radio frequency monitoring of Turbine-Generators Project.** Hilson, D.W.; Carter, C.L.; Sadanandan, N.D.; Grant, J.B.; Morris, K.W. (Tennessee Valley Authority, Chattanooga (USA). Office of Power; Tennessee Valley Authority, Chattanooga (USA). Div. of Energy Demonstrations and Technology). Dec 1986. 132p. NTIS, PC A07/MF A01. File Number DE87900853.

This report summarizes the activities of the Radio Frequency (RF) Monitoring of Turbine-Generators Project for the period of fiscal year 1983 to fiscal year 1985. The project objective was to determine if RF monitoring would provide early detection of abnormal arcing in turbine-generators. RF measurements have been performed on selected generators within the Division of Fossil and Hydro Power and the Office of Nuclear Power of the Tennessee Valley Authority. The only known problem on a machine that has been monitored is on the Paradise unit 3A. This problem involved vent space sheet migration into the slots, and it was suspected of causing winding insulation damage. RF measurements were made before and after the repair. When repaired, the insulation was found not to be severely damaged. The RF signal levels decreased slightly after the repair. The data base developed so far for the other machines consists of RF-spectrum signatures of the respective turbine-generators. No known problems exist on these machines.

41611 **(UCID—20919) MaRV [maneuverable reentry vehicles] PoP [probability of penetration] vs CEP [circular error probability] analysis concept study (MaRV Penetration Study Project).** Morris, J.M. (Lawrence Livermore National Lab., CA (USA)). 1 Aug 1986. Contract W-7405-ENG-48. 20p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011903.

The performance analysis of maneuverable reentry vehicles (MaRV) in terms of its probability of penetration (PoP) against terminal engagement with a ballistic missile defense (BMD) system and in terms of its associate circular error probability (CEP), at impact is a very complex problem. A thorough study of this problem under the MaRV Penetration Study Project will require the development of a number of analytical and simulation tools. As a result of a preliminary study, a MaRV PoP vs CEP analysis concept has been formulated to support the MaRV Penetration Study Project. The concept is based on analytical models and techniques and, moreover, exploits the existing knowledge base and is physically intuitive. The analysis concept, as formulated, is applicable to arbitrary MaRV's and BMD systems.

41612 **(UCID—21087) Phenomenology of electromagnetic coupling: Conductors penetrating an aperture.** Wright, D.B.; King, R.J. (Lawrence Livermore National Lab., CA (USA)). Jun 1987. Contract W-7405-ENG-48. 44p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011901.

The purpose of this study was to investigate the coupling effects of penetrating conductors through free-standing apertures. This penetrating conductor and aperture arrangement are referred to as a modified aperture. A penetrating conductor is defined here to be a thin, single wire bent twice at 90° angles. The wire was inserted through a rectangular aperture in a metal wall. Vertical segments on both sides of the wall coupled energy from one region to the other. Energy was incident upon the modified aperture from what is referred to as the exterior region. The amount of coupling was measured by a D sensor on the other (interior) side of the wall. This configuration of an aperture in a metal wall was used as opposed to an aperture in a cavity in order to simplify the interpretation of resulting data. The added complexity of multiple cavity resonances was therefore eliminated. Determining the effects of penetrating conductors on aperture coupling is one of several topics being investigated as part of on-going research at Lawrence Livermore National Laboratory on the phenomenology of electromagnetic coupling. These phenomenology studies are concerned with the vulnerability of electronic systems to high intensity electromagnetic fields. The investigation is relevant to high altitude EMP (HEMP), enhanced HEMP (EHEMP), and high power microwave (HPM) coupling.

41613 **(UCRL—94285) The phenomenology of intense electromagnetic wave interactions with systems.** Cabayan, H.S. (Lawrence Livermore National Lab., CA (USA)). 12 Mar 1986. Contract W-7405-ENG-48. 9p. (CONF-8604341—1; CONF-8606317—1). NTIS, PC A02. File Number DE87009561.

From Electromagnetic Compatibility Society Institute for Electrical and Electronics Engineers; San Jose, CA, USA (29 Apr 1986).

Recent advances in laboratory high power microwave (HPM) source capabilities have raised concerns regarding the survivability of US systems if HPM weapon systems using such sources are deployed in the battlefield. In this paper an overview of recent US achievements in HPM sources is given. Upper bounds to future HPM threats on targets from first principles are derived. Again using a simplified first principles approach, the phenomenology of HPM interaction with targets is examined and scaling laws

for the target response with frequency, pulse width, and fluence are derived.

41614 **Conversion tables for pressure and leak rates.** Moss, T.A. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **5**: No. 5, 2962-2965(Sep 1987). Contract AC04-76DP00789.

Two new conversion tables are presented that relate pressure and leak rates. These tables are more accurate than other than previously publishe d conversion tables. The temperature dependence of the gas leak rate must be used to convert to the temperature independent mass/time units. (AIP)

41615 **Dense crystalline ZrO_2 thin films deposited by pulsed-laser evaporation.** Sankur, H.; DeNatale, J.; Gunning, W.; Nelson, J.G. (Rockwell International Science Center, Thousand Oaks, California 91360). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **5**: No. 5, 2869-2874(Sep 1987).

A TEA-CO_2 laser was used to evaporate solid targets of ZrO_2 at power densities of 0.25 to 1.5 x 10^9 W/cm^2. The laser-generated plasma contained ions with velocities in the 2—6 x 10^6 cm/s range. This ion flux normal to and 7.5 cm away from the solid source was in the range of 0.25 to 2.5 x 10^{14}/cm^2/laser pulse for the above power density range. ZrO_2 thin films deposited by this technique were characterized for their optical and structural properties. Under a broad range of laser power densities, these films had bulk-like refractive index values, low absorption, and oriented polycrystalline microstructure.

41616 **Orienting members in a preselected rotary alignment.** Williams, R.E. (to Dept. of Energy, Washington, DC). US Patent 4,674,774. 23 Jun 1987. Filed date 29 Nov 1984. vp.

This patent describes an apparatus for orienting first and second members in a preselected rotary alignment and for maintaining their rotary alignment during orientation. The apparatus comprises: a first cylindrical element having an outside wall and first and second ends, each of the ends having an outside edge, the first cylindrical element having portions defining notches disposed in a spaced-apart pattern at the outside edge of the first end, the first cylindrical element having an external threaded portion disposed on the outside wall and adjacent to notches, the first cylindrical element being connected at its second end to the first member; a second cylindrical element having an outside wall and first and second ends, each of the ends having an outside edge, the first end of the second cylindrical element having substantially the same outside diameter as the first end of the first cylindrical element; a rotation prevention element for placement within the cavity, the rotation prevention element being sufficiently large relative to the cavity to prevent rotation of the overlapping first cylindrical element notch past the overlapping second cylindrical element notch; and a collar slidably disposed about the second cylindrical element, having an internal threaded portion for interfittably engaging portion of first cylindrical element to connect second and first cylindrical elements.

41617 **(RAE-Lib-Trans—2103) WSUH-1D: Review of damage following lightning strike, 30 November 1981.** Gobl, T.A. (Royal Aircraft Establishment, Farnborough (UK)). 4 Sep 1986. Translation of Technical Inspection Report 29/81 BWB-ML. 39p. (In English). NTIS (US Sales Only), PC A03/MF A01. File Number DE87900910.

This report describes an investigation into the effects of a lightning strike to a BELL UH-1D helicopter operated by the German Air Force. The investigation was made by the Aircraft System Investigation Section of the Air Force Service Regiment, at ERDING. Lightning attachments occurred to one main rotor blade, one tail rotor blade and to one undercarriage skid. It was found that arcing had occurred within the aluminum honeycomb core of the main rotor blade sufficient to initiate fatigue cracks in the trailing-edge extrusion. Arcing had also occurred within bearings and between moving parts of the rotor head mechanism. The damage to the rotor head was revealed during routine maintenance and rectification of leaking hydraulic actuators rather than by post-strike inspection. Some of the internal damage to the rotor blade only became evident when the blade was dismantled and was not detectable by NDT methods. Voltage surges induced into the helicopter electrical system caused failure of certain equipment.

41618 **(RAE-Lib-Trans—2143) Developments in air traffic control systems and their relation with meteorology.** Hagenberg, T.H.M. (Royal Aircraft Establishment, Farnborough (UK)). 9 Jan 1986. Translation of Report No. NLR MP 84029 U, March 1984. 22p. (In English). NTIS, PC A02. File Number DE87900911.

This paper describes in overall terms the organization of flight safety and its relation with meteorology. It proceeds to deal with new future systems and the resulting new potential possibilities for progressive automation of the air traffic control system.

4203 Lasers

REFER ALSO TO CITATION(S) 40697, 41324, 42797, 42813, 42814, 42816, 42817, 42820, 42822, 42823

41619 **(DOE/ER/25019—4) The effects of wiggler taper rate and signal field gain rate in free-electron lasers.** Li, Y.P.; Kevorkian, J. (Washington Univ., Seattle (USA). Dept. of Applied Mathematics). 1987. Contract FG06-86ER25019. 33p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011830.

Derived is a dimensionless formulation of the motion of electrons in free electron lasers with tapered wigglers and systematically account for the cumulative effects of tapering and signal field gain. The mathematical problem involves three small parameters: ϵ, measuring the slowness of spatial variations of the wiggler field, μ, the ratio of signal wave length to wiggler period, and κ, the square of the ratio of the plasma frequency to signal frequency. We identify two distinguished limits governing the relation between μ and ϵ, and three distinguished limits governing the relation between κ and ϵ. The mathematical problems which result consist of the solution of strictly nonlinear oscillators with slowly varying parameters and small perturbation terms. Techniques from the asymptotic theory of nonlinear oscillations are used to derive results pertinent for FEL problems.

41620 (INIS-mf—10917, pp 28) **Metal vapor lasers: recent advances and applications.** Webb, C.E. (Oxford Univ., UK. Clarendon Lab.). 1986. NTIS (US Sales Only), PC A07/MF A01. File Number DE87780153. (CONF-860919—Absts.).

From 6. international symposium on gas flow and chemical lasers; Jerusalem, Israel (8 Sep 1986).

41621 (INIS-mf—10917, pp 35) **New developments in optical phase conjugation.** Bigio, I.J. (Los Alamos National Lab., NM, USA). 1986. NTIS (US Sales Only), PC A07/MF A01. File Number DE87780153. (CONF-860919—Absts.).

From 6. international symposium on gas flow and chemical lasers; Jerusalem, Israel (8 Sep 1986).

41622 (INIS-mf—10917, pp 46) **Laser pulse deformations in KrF amplifier.** Badziak, J.; Dubicki, A. (Institute of Plasma Physics and Laser Microfusion, Warsaw, Poland). 1986. NTIS (US Sales Only), PC A07/MF A01. File Number DE87780153. (CONF-860919—Absts.).

From 6. international symposium on gas flow and chemical lasers; Jerusalem, Israel (8 Sep 1986).

41623 (INIS-mf—10917, pp 51) **Experimental studies and kinetic modelling of an HF chemical laser at low temperature.** Waichman, K.; Chuchem, D.; Kalisky, Y. (Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev). 1986. NTIS (US Sales Only), PC A07/MF A01. File Number DE87780153. (CONF-860919—Absts.).

From 6. international symposium on gas flow and chemical lasers; Jerusalem, Israel (8 Sep 1986).

41624 (INIS-mf—10917, pp 59) **Flow investigations of pulsed arc discharge recombination lasers.** Schall, W.O.; Mayerhofer, W.; Spindler, G. (DFVLR-Inst. fuer Technische Physik, Stuttgart, Germany, F.R.). 1986. NTIS (US Sales Only), PC A07/MF A01. File Number DE87780153. (CONF-860919—Absts.).

From 6. international symposium on gas flow and chemical lasers; Jerusalem, Israel (8 Sep 1986).

41625 **(INIS-mf—10917) 6. International Symposium on Gas Flow and Chemical Lasers: Program and Abstracts.** (Ben-Gurion Univ. of the Negev, Beersheba (Israel); Israel Academy of Sciences and Humanities, Jerusalem; Israel Laser and Electro-Optics Society). 1986. vp. (CONF-860919—Absts.). NTIS (US Sales Only), PC A07/MF A01. File Number DE87780153.

From 6. international symposium on gas flow and chemical lasers; Jerusalem, Israel (8 Sep 1986).

Individual papers have been cataloged separately. (WRF)

41626 **(UCID—20653) Heat transfer/fluid mechanics for a ten-slab nitrogen-cooled glass laser amplifier.** Blink, J.A. (Lawrence Livermore National Lab., CA (USA)). 30 Sep 1985. Contract W-7405-ENG-48. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011915.

A parameter study was carried out for a Gas-Cooled Slab (GCS) amplifier with 10 glass slabs, using the 1DFLOW code. The 1DFLOW code was improved by adding graphing capability, automating the nozzle and diffuser design procedure, extending heat transfer correlations, and providing for a variable preheating length to account for ASE heating of the coolant. The three flow geometries investigated are parallel flow through the twenty flow circuits (top to bottom through the channels on both sides of the ten slabs); alternating flow (down one channel, up another, down a third, etc.); series flow in two circuits, one on each side of the amplifier (horizontal flow across a slab, turning in a common slab holder, horizontal flow across the next slab, etc.). The parallel flow geometry was chosen as the best geometry. It has the easiest gas plumbing and the lowest slab temperatures, and the flow rates are reasonable even though they are higher than the other geometries. The alternating geometry was rejected because of relatively high slab temperatures and because of the difficulty of constructing the gas flow connections between the (alternating Brewster angle) slabs. The series geometry was rejected because of its extended nonlinear temperature region and because of the difficulty of constructing the slab holders for continuous flow between slabs.

41627 **(UCRL—52000-87-7) Energy and Technology Review: The State of the Laboratory.** (Lawrence Livermore National Lab., CA (USA)). Jul 1987. Contract W-7405-ENG-48. 92p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87013319.

Short summaries are given of present research programs at Lawrence Livermore Laboratory. These program summaries are organized in the report according to subject matter in the following categories: defense systems; laser research; magnetic fusion energy; beam research; biomedical, environmental and energy sciences; and physical science and engineering. 56 figs., 8 tabs. (DWL)

41628 **Frequency tripling into the 720—1025-A region with pulsed free jets.** Page, R.H.; Larkin, R.J.; Kung, A.H.; Shen, Y.R.; Lee, Y.T. (Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Review of Scientific Instruments;* **58**: No. 9, 1616-1620(Sep 1987). Contract AC03-76SF00098.

We have developed a coherent source of XUV light, which is continuously tunable between 904 and 1024 A, and line tunable to 720 A. It employs the technique of frequency tripling in a pulsed free jet of gas, and requires a single tunable laser system. Spectra of the relative XUV output vs wavelength in the 904—1024-A range are presented for the tripling gases Ar, Kr, Xe, CO, and N_2. Also listed are relative outputs obtained by tripling at resonantly enhanced lines between 720 and 900 A in Kr, Xe, and CO. Possible improvements to the source are discussed, and examples of its application are given.

41629 **Diagnostic apparatus and method for use in the alignment of one or more laser means onto a fiber optics interface.** Johnson, S.A.; Shannon, R.R. (to Department of Energy, Washington, DC). US Patent 4,673,290. 16 Jun 1987. Filed date 18 Jan 1985. vp.

This patent describes a diagnostic apparatus for use in the alignment of one or more beams onto a fiber optics interface. The diagnostic apparatus comprises: monitor means; lens assembly means for imaging one or more of laser beams passing through an aperture onto the fiber optics interface. The assembly means is slightly offset in an optical orientation from its center line optical axis. The lens assembly means includes at least one lens where the one lens includes reflection means on the rear surface of one lens such that when a minor scattering of laser beams are reflected from the interface back to the lens assembly means, the reflection means on one lens reflects, images and directs the scattered light toward the monitor means; the monitor means is optically oriented to permit monitoring of reflected light for indirect observation of the alignment of focused laser beams onto the fiber optics interface.

41630 **Methods for tuning free electron lasers to multiple wavelengths.** Colson, W.B. (to Secretary of the Air Force, Washington, DC). US Patent 4,674,091. 16 Jun 1987. Filed date 14 Aug 1985. vp.

This patent describes a free electron laser which has a resonator with a resonator axis formed by mirrors which face each other and have optical waves bouncing back and forth between them along an optical path. They are linearly polarized magnets producing a transverse, periodic magnetic field which extends into the resonator. An accelerator injects a relativistic electron beam along an electron beam path through the transverse, periodic electric field in the resonator to oscillate and amplify the optical waves in a stimulated emission of radiation to produce a coherent and monochromatic laser oscillation. This optical wavelength has a polarization which is the same as that of the transverse magnetic field. The specific improvement comprises a process of tuning the laser oscillation to different wavelengths by a rotation of the resonator axis with respect to the electron beam path and the transverse periodic magnetic field.

41631 **Small-signal gain for a planar FEL with a periodic magnetic field.** Elliot, C.J.; Schmitt, M.J. (Los Alamos National Lab., Los Alamos, NM). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science;* **PS-15**: No. 3, 319-326(Jun 1987).

The authors describe computation of the small-signal normal modes for a Compton regime free-electron laser (FEL) with an arbitrary periodic magnetic field. The work shows how to extend the previously known sinusoidal results into the low-energy regime and also how to describe consequences of periodic magnetic fields at arbitrary e-beam energy. The formalism has an a posteriori requirement that the calculated gain or phase shift be small over a wiggler period. The concept of coupling coefficients applies to these generalized conditions, and provides a unified description of this large class of cases. The formalism is based on the classical one-dimensional Vlasov-Maxwell equations, without an Abraham-Lorentz model of radiation reaction.

41632 **KrF laser studies at high krypton density.** Mandi, A.E.; Klimek, D.E.; Salesky, E.T. (Avco Research Lab., Inc., Everett, MA 02149). *Fusion Technology;* **11**: No. 3, 542-547(May 1987).

Measurements were made of the intrinsic laser efficiency of the KrF excimer laser system as a function of increasing krypton buffer gas at pump rates up to 0.17 MW/cm/sup 3/. The results show that the laser efficiency monotonically increases with increased krypton concentration to a maximum value of 12% for a pure krypton buffer gas. Code calculation shows very good agreement with experiment.

41633 **Thermal effects in gain-guided diode laser arrays.** Hadley, G.R.; Hohimer, J.P.; Owyoung, A. (Div. 1124, Sandia National Labs., Albuquerque, NM 87185-5800). pp 172-174 of Topical meeting on semiconductor lasers (Summaries). Washington, DC; Optical Society of America (1987). (CONF-870220—). Contract AC04-76DP00789.

From Southwest optics conference; Albuquerque, NM, USA (9 Feb 1987).

The authors present here the results of calculations of the eigenmodes of a ten-stripe gain-guided diode laser array, performed with a numerical model which treats the array as a broad-area resonator. Our model includes the effects of electron diffusion in the active region, gain saturation, and index anti-guiding. They show that the addition of junction heating to the model has a profound effect on both the near- and far-field profiles of the eigenmodes and their modal gains. Indeed, junction heating effects are largely responsible for the appearance of high-order modes in the cw operation of gain-guided arrays.

41634 **Injection-seeding studies of diode laser array behavior.** Hohimer, J.P.; Hadley, G.R.; Owyoung, A. (Sandia National Labs., Albuquerque, NM 87185-5800). pp 179-182 of Topical meeting on semiconductor lasers (Summaries). Washington, DC; Optical Society of America (1987). (CONF-870220—). Contract AC04-76DP00789.

From Southwest optics conference; Albuquerque, NM, USA (9 Feb 1987).

The authors show the value of injection seeding in the study of the behavior of gain-guided diode laser arrays. This method has provided a means for discovering the nature of the inter-element coupling in these devices and has shown the similarity between gain-guided arrays and gain-perturbed broad-area devices. Injection seeding has also allowed them to observe the range of possible eigenmodes in gain-guided arrays rather than only the high-gain modes which appear in free-running arrays. The ability to realize detailed observations of the high-order eigenmodes and to make comparisons of these modes with theory has in turn led to an appreciation of the importance of thermal effects in modeling these devices. This development of a comprehensive model for gain-guided arrays lead to improvements in the operating characteristics of future devices.

41635 **Inductively stabilized excimer lasers.** Sze, R.C. (Los Alamos National Lab., Los Alamos, NM 87545). pp 5-6 of Excimer lasers and optics. Luk, T.S. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-8609127—).

From SPIE symposium on optics and optoelectronics; Cambridge, MA, USA (14 Sep 1986).

The author reviews the work at Los Alamos regarding long pulse excimer laser operation using the technique of inductive stabilization of avalanche discharges. This technique, depending on the rate of energy deposition, has allowed laser pulse lengths of greater than 120 ns and total lasing times greater than 200ns. Small lasers employing this technique are particularly useful in the control of large amplifiers to obtain narrow linewidth, near diffraction limited operation as well as in the amplification of mode-locked pulse trains to further enhance the brightness of the laser system. The performance of small lasers with short cavity length used for narrow-band frequency tuning, active modelocking and the advantages associated with high repetition rate operation are discussed. The scaling to longer gain lengths and to high average power systems are also discussed. Finally, a brief discussion of the potential uses of small long pulse devices in the areas of high brightness sources, medical and semiconductor applications is given.

41636 **Review of UV laser damage measurements at Lawrence Livermore National Laboratory.** Rainer, F.; Hildum, E.A. (Lawrence Livermore National Lab., P.O. Box 5508, L-490, Livermore, CA 94550). pp 74-84 of Excimer lasers and optics. Luk, T.S. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-8609127—). Contract W-7405-ENG-48.

From SPIE symposium on optics and optoelectronics; Cambridge, MA, USA (14 Sep 1986).

Laser damage threshold measurements in the ultraviolet (UV) have been made at the Lawrence Livermore national laboratory (LLNL) since 1979. These tests were conducted using single pulses at the third (355 nm) and fourth (266 nm) harmonic wavelengths of 1064-nm Nd-glass lasers, and single and repetitively fired pulses from KrF (248 nm) and XeF (351 nm) excimer lasers respectively. Surface damage thresholds of dielectric thin films, antireflective (AR) coatings, highly reflective (HR) coatings, and porous and graded-index AR coatings, as well as surface and bulk thresholds of optical windows and crystals have been measured. More than twenty different parameter studies have been conducted to develop materials with increased laser damage thresholds.

41637 **High order multiphoton processes observed with subpicosecond excimer lasers.** Luk, T.S.; Hutchinson, M.H.R.; Jara, H.; Johann, U.; Mc Intyre, I.A.; Mc Pherson, A.; Schwarzenbach, A.P.; Boyer, K.; Rhodes, C.K. (Dept. of Physics, Univ. of Illinois at Chicago, P.O. Box 4348, Chicago, IL 60680). pp 99-102 of Excimer lasers and optics. Luk, T.S. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-8609127—).

From SPIE symposium on optics and optoelectronics; Cambridge, MA, USA (14 Sep 1986).

A subpicosecond excimer laser source with 30 GW peak power has been developed. The interaction mechanism at a laser intensity of up to 10/sup 16/ W/cm/sup 2/ has been studied using ion and electron time of flight techniques. The laser system used in the experiment described in this paper has been reported in detail. This source, which produces — 30 GW peak power at 248 nm, has been focussed to a maximum intensity of — 10/sup 16/ W/cm/sup 2/ in studies of multiphoton processes.

41638 **VUV fluorescence and harmonic generation with intense picosecond 248 nm KrF radiation.** Mc Pherson, A.; Luk, T.S.; Hutchinson, M.H.R.; Jara, H.; Johann, U.; Mc Intyre, I.A.; Schwarzenbach, A.P.; Boyer, K.; Rhodes, C.K. (Dept. of Physics, Univ. of Illinois at Chicago, P.O. Box 4348, Chicago, IL 60680). pp 103-108 of Excimer lasers and optics. Luk, T.S. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-8609127—).

From SPIE symposium on optics and optoelectronics; Cambridge, MA, USA (14 Sep 1986).

A picosecond 248 nm KrF laser system producing a focal intensity of greater than 10/sup 15/ W/cm/sup 2/ has been used to study VUV fluorescence and harmonic generation in H/sub 2/, He, Ne, Ar, Kr, and Xe. The nonlinear media were found to fall into two distinct classes: the lighter materials, H/sub 2/, He, and Ne, which readily support the generation of harmonic radiation, but do not fluorescence, and the heavier materials, Ar, Kr, and Xe, which produce significant amounts of fluorescence, but in which the generation of harmonic radiation decreases rapidly with the scattering order. In this study, the authors present the results of experiments examining the radiation produced as a consequence of the atomic interaction with the intense laser field. In these experiments, both fluorescence from electronically excited ions (A/sup q+/) and harmonics of the incident wave produced by parametric scattering have been observed. The character of these radiations gives additional information on the nature of the atomic interaction with the intense incident wave.

4204 Heat Transfer And Fluid Flow

REFER ALSO TO CITATION(S) 40404, 40406, 40411, 40915, 40941, 40986, 41028, 41045, 41678

41639 **(CONF-861204—10) Forced-convective vaporization of refrigerants in spirally fluted tubes.** Panchal, C.B.; France, D.M.; Stellman, R.S. (Argonne National Lab., IL (USA); Illinois Univ., Chicago (USA)). 1986. Contract W-31109-ENG-38. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011352.

From 4. Miami international symposium on multi-phase transport and particulate phenomena; Miami Beach, FL, USA (15 Dec 1986).

Subcooled and bulk flow boiling heat transfer were studied experimentally inside of spirally fluted tubes. Forty-eight tests were

performed using refrigerant-11 flowing upwards inside the 84 spirally fluted tubes of the test section. The maximum heat supply of 675 kW was provided by steam condensing on the outside of the 4.45 m long aluminum tubes. The mean tube diameter (diameter of a round tube with the same flow area) was 26.77 mm, and flute depth was 1.54 mm at an angle of 30 degrees relative to the tube axis. Experiments were performed with a refrigerant-11 pressure range of 296 to 1010 kPa and mass flux range of 60 to 183 kg/m^{2}s. Test results were analyzed and predictive relations were developed in three sections: local subcooled boiling heat transfer, average bulk boiling heat transfer, and local heat transfer in bulk boiling. The results showed that, on an average basis, the bulk boiling heat transfer coefficient in the spirally fluted tubes was higher than in equivalent flow area round tubes by a factor of 1.8. The relations developed for calculation of local heat transfer coefficients in subcooled and bulk boiling were used to predict heat transfer parameters as a function of test section length. The predicted exit qualities compared well with the data.

41640 (CONF-870320—3) Two-fluid model for two-phase flow. Ishii, M. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 65p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87011498.

From Department of Energy international workshop on two-phase flow fundamentals; Troy, NY, USA (16 Mar 1987).

The two-fluid model formulation is discussed in detail. The emphasis of the paper is on the three-dimensional formulation and the closure issues. The origin of the interfacial and turbulent transfer terms in the averaged formulation is explained and their original mathematical forms are examined. The interfacial transfer of mass, momentum, and energy is proportional to the interfacial area and driving force. This is not a postulate but a result of the careful examination of the mathematical form of the exact interfacial terms. These two effects are considered separately. Since all the interfacial transfer terms involve the interfacial area concentration, the accurate modeling of the local interfacial area concentration is the first step to be taken for a development of a reliable two-fluid model closure relations. The interfacial momentum interaction has been studied in terms of the standard-drag, lift, virtual mass, and Basset forces. Available analytical and semi-empirical correlations and closure relations are reviewed and existing shortcomings are pointed out. The other major area of importance is the modeling of turbulent transfer in two-phase flow. The two-phase flow turbulence problem is coupled with the phase separation problem even in a steady-state fully developed flow. Thus the two-phase turbulence cannot be understood without understanding the interfacial drag and lift forces accurately. There are some indications that the mixing length type model may not be sufficient to describe the three-dimensional turbulent and flow structures. Although it is a very difficult challenge, the two-phase flow turbulence should be investigated both experimentally and analytically with long time-scale research. 87 refs.

41641 (CONF-8705148—1) Analytical and experimental studies of flow-induced vibration of SSME components. Chen, S.S.; Jendrzejczyk, J.A.; Wambsganss, M.W. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011418.

From NASA conference on structural integrity and durability of reusable space propulsion systems; Cleveland, OH, USA (11 May 1987).

Components of the SSMEs are subjected to a severe environment that includes high-temperature, high-velocity flows. Such flows represent a source of energy that can induce and sustain large-amplitude vibratory stresses and/or result in fluidelastic instabilities. Three components are already known to have experienced failures in evaluation tests as a result of flow-induced structural motion. These components include the liquid-oxygen (LOX) posts, the fuel turbine bellows shield, and the internal inlet tee splitter vane. Considered are the dynamic behavior of each of these components with varying degrees of effort: (1) a theoretical and experimental study of LOX post vibration excited by a fluid flow; (2) an assessment of the internal inlet tee splitter vane vibration (referred to as the "4000-Hz vibration problem"); and (3) a preliminary consideration of the bellows shield problem. This paper summarizes our effort in the resolution of flow-induced vibration problems associated with the SSMEs.

41642 (CONF-8709107—1) Motion-dependent fluid forces acting on a tube row in crossflow. Jendrzejczyk, J.A.; Chen, S.S. (Argonne National Lab., IL (USA)). Jan 1987. Contract W-31109-ENG-38. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011404.

From American Society of Mechanical Engineers vibration conference; Boston, MA, USA (27 Sep 1987).

Motion-dependent fluid forces acting on a tube row with a pitch-to-diameter ratio of 1.35 are measured for several flow velocities and a series of oscillation frequencies. Fluid-damping and fluid-stiffness coefficients are obtained from motion-dependent fluid forces as a function of reduced flow velocity. Fluid-force coefficients agree reasonably with published data. Based on the fluid-force coefficients, the critical flow velocity and instability characteristics of tube arrays in crossflow can be predicted.

41643 (DOE/ER/04054—10) Study of the time dependent transmisivity of joints in rock: Final report. Scholz, C.H.; Engelder, T. (Columbia Univ., Palisades, NY (USA). Lamont-Doherty Geological Observatory). Feb 1987. Contract AC02-76ER04054. 6p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87010882.

An experimental study was made of the fundamentals of fluid flow through joints in rock. Experiments showed that the permeability of joints subjected to compressive loads obeyed the 'cubic' law to the first approximation, but that this property also exhibited hysteresis and major departures from the 'cubic' law at high pressures and small apertures. Hysteresis was found to result from frictional interactions during joint contact. A contact theory was developed and tested that explicitly predicts joint closure and permeability as a function of normal stress and the topography of the surfaces. The role of solution and dissolution along the joint wall on permeability was studied using hot aqueous fluids as the transported medium.

41644 (DOE/MC/21353—2372) A review of granular stress constitutive relations. Syamlal, M. (EG and G/Washington Analytical Services Center, Inc., Morgantown, WV (USA)). Jan 1987. Contract AC21-85MC21353. 25p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006499.

Hydrodynamic modeling of fluidization uses a framework in which the fluid and the particles are modeled as interpenetrating continua. For the application of the theory to specific problems, several constitutive equations that describe the material responses are required. Among these, the constitutive equation for the granular stress tensor, however, has not yet been formulated satisfactorily. In earlier studies, a Newtonian viscosity model was used to describe granular stresses. Such models are questionable, since the rheological behavior of granular media is quite different from that of Newtonian fluids. A good source of more suitable granular stress models is literature on granular flow/soil mechanics. The objective of this report is to review this literature and to identify a granular stress model that can be used in hydrodynamic models of fluidization. A brief review of the viscosity values reported for fluidized beds indicates that the granular stresses in a fluidized bed are important, and therefore, there is a need for a good granular stress model. However, in the absence of a good general theory for computational purposes, it is best to adopt the theory by Lun and others (1984) for rapid flow, since the collision effects in a fluidized bed are more important under most circumstances than frictional effets. 45 refs.

41645 (GKSS—87/E/3) Fluid similarity of the boiling crisis. Katsaounis, A. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude, Germany, F.R. Inst. fuer Anlagentechnik). (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.); GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Anlagentechnik). 1987. 8p. (In German). NTIS, PC E07; Available from NTIS as TIB/B87-07811.

Most of the measurements related to the boiling crisis have, until now, been undertaken for a wide parameter variation in the water, and were mainly related to the water-cooled reactor. This article investigates, whether or how the measuring results can be

transferred to other fluids. Derived dimensionless similarity figures and those taken from literature are verified by measurements from complex geometries in water and freon 12.

41646 **(KU-HCOE-FL2-R—86-6) Finite-time thermodynamics of a porous plug.** Brown, G.R.; Snow, S.; Andresen, B.; Salamon, P. (Copenhagen Univ. (Denmark). H.C. Oersted Inst.). 1986. 43p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87752327.

Three related systems, two of which describe diffusion of an ideal gas through a porous plug, are optimized so as to minimize the work required to move the plug from one equilibrium position to another equilibrium position in a given time tau. All systems follow a 'turnpike' trajectory, and the dissipation (work required) is proportional to (Δl)/sup 2//tau, where Δl is the distance moved, at least for slow processes. The result is of interest as a lower bound for the separation of gases by diffusion.

41647 **(LA-UR—87-117) A theoretical prediction of critical heat flux in saturated pool boiling during power transients.** Pasamehmetoglu, K.O.; Nelson, R.A.; Gunnerson, F.S. (Los Alamos National Lab., NM (USA); University of Central Florida, Orlando (USA). Coll. of Engineering). 1987. Contract W-7405-ENG-36. 24p. (CONF-870816—4). NTIS, PC A02/MF A01; GPO Dep. File Number DE87005109.

From 24. national heat transfer conference and exhibition; Pittsburgh, PA, USA (9 Aug 1987).

Understanding and predicting critical heat flux (CHF) behavior during steady-state and transient conditions is of fundamental interest in the design, operation, and safety of boiling and two-phase flow devices. Presented within this paper are the results of a comprehensive theoretical study specifically conducted to model transient CHF behavior in saturated pool boiling. Thermal energy conduction within a heating element and its influence on the CHF are also discussed. The resultant theory provides new insight into the basic physics of the CHF phenomenon and indicates favorable agreement with the experimental data from cylindrical heaters with small radii. However, the flat-ribbon heater data compared poorly with the present theory, although the general trend was predicted. Finally, various factors that affect the discrepency between the data and the theory are listed.

41648 **(LBL—23521) A comparison of velocity and scalar spectra in premixed turbulent flames.** Cheng, R.K.; Shepherd, I.G.; Gokalp, I. (Lawrence Berkeley Lab., CA (USA); California Univ., Berkeley (USA). Dept. of Mechanical Engineering; Centre National de la Recherche Scientifique, 45 - Orleans-la-Source (France). Centre de Recherches sur la Chimie de Combustion et des Hautes Temperatures). May 1987. Contract AC03-76SF00098. 10p. (CONF-870989—1). NTIS, PC A02. File Number DE87011099.

From 6. symposium on turbulent shear flow; Toulouse, France (7 Sep 1987).

Scalar (intermittency) and velocity spectra in premixed methane/air turbulent v-flames and stagnation flow stabilized flames have been measured using laser light Mie scattering and laser Doppler anemometry techniques. To compare the velocity spectra of the oblique v-flame with those of the normal stagnation flames, the velocity data for v-flames are transformed to obtain the spectra of the velocity components normal and tangential to the oblique flame zone. In both configurations, the spectra of the normal velocity components are similar to the corresponding scalar spectra. The most energetic frequencies are consistent with the flame passage frequencies demonstrating clearly that the velocity and scalar spectra are strongly coupled. However, the most energetic frequencies are about an order of magnitude higher in the v-flame than in the stagnation flames even though the incidence turbulence of the two flames are similar. Since this difference does not seem to be proportional to the difference in the mean velocities, our results imply that the spatial scales in the two flame zones are not the same.

41649 **(NP—7770183) Morphological and quantitative results regarding an unstable ring vortex, whose vibration in the turbulent flow condition is reinforced by a free jet.** Schneider, P.E.M. (Max-Planck-Institut fuer Stroemungsforschung, Goettingen (Germany, F.R.)). Feb 1982. 48p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE87770183.

The author describes the ring vortices, which are formed by an impulse from liquid pushed through a circular nozzle opening. The main point of this paper is the investigation on the behaviour of a ring vortex with a circular closed vortex axis. The literature is also introduced and the test rig is explained. (HAG).

41650 **(NP—7770234) On the dispersion of the propagation speed of weak pressure waves in two-phase mixtures, shown on the example of wet steam.** Croonenbrock, R. (Technische Hochschule Aachen (Germany, F.R.). Fakultaet fuer Maschinenwesen). 10 Jul 1985. 133p. (In German). NTIS (US Sales Only), PC A07. File Number DE87770234.

The author describes the problems which occur in the flow of compressible fluids through thermal flow machines. The interactions between the phase present as particles and the fluid carrying the particles with dispersed distributed phases are examined. Apart from deriving the speed of sound in the two phase area of steam, and the development of a model for the build-up of a two phase mixture 'wet steam', the exchange mechanisms between the carrier gas and the drops are considered. Further, basic equations of two phase flow are dealt with and the dispersion equations for the speed of sound are discussed. Finally, the results of measurements are compared with the theoretical model of sound propagation in the two phase field. (HAG).

41651 **(SAND—87-0063C) An aerodynamic model for a hemispherically-capped biconic reentry vehicle with six drag flaps.** Jordan, T.M.; Buffington, R.J. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 15p. (CONF-870830—6). NTIS, PC A02. File Number DE87010476.

From AIAA aerodynamics flight mechanics conference; Monterey, CA, USA (17 Aug 1987).

The development of an aerodynamic model for a hemispherically-capped biconic reentry vehicle with six drag flaps is presented. The aerodynamic model is primarily based on wind tunnel test results, with the use of computational fluid dynamic codes. For Mach numbers from 4 to 15, the inviscid axial force coefficient was computed for drag flap deflections from 6° to 36°. Axial force coefficient was found to vary significantly with ablating flap shape as well as with changing flight conditions. The aerodynamic model can be used for input to vehicle recovery trajectory simulations.

41652 **(SFB—210/T-29) Development of a finite volume procedure for prediction of fluid flow problems with complex irregular boundaries.** Majumdar, S. (Karlsruhe Univ. (T.H.) (Germany, F.R.). Sonderforschungsbereich 210 Stroemungsmechanische Bemessungsgrundlagen fuer Bauwerke). Dec 1986. 73p. NTIS (US Sales Only), PC A04. File Number DE87770223.

This report documents a finite volume procedure developed for calculation of two-dimensional, steady, incompressible flows with complex irregular flow boundaries. Nonorthogonal coordinate system with non-staggered variable arrangement and cartesian velocities has been used in the present procedure. The first part of the report describes the mathematical basis of the procedure, viz., the governing differential equations, their discretisation and the solution method. The second part covers typical application of the procedure for calculation of a few inviscid, laminar and turbulent flow situations. The accuracy and the stability of the present procedure is validated against experimental or other numerical results. The present work however forms the first stage in the development of a general method for predicting three-dimensional turbulent recirculating flows.

41653 **(UCID—21054) A brief review on cavitation bubble collapse near a solid boundary.** Steinberg, D.J. (Lawrence Livermore National Lab., CA (USA)). Jun 1987. Contract W-7405-ENG-48. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013116.

A brief review of cavitation bubble collapse near a solid boundary includes a comprehensive bibliography with 67 citations of work published since 1960. The 67 references presented here deal almost solely with cavitation bubble collapse in the vicinity of a rigid wall or boundary.

41654 **(UCRL—15922) Rayleigh-Taylor instability in compressible fluids: Final report for the period 24 September 1984-23 September 1985.** Sturtevant, B. (California Inst. of Tech., Pasadena (USA). Graduate Aeronautical Labs.; Lawrence Livermore National Lab., CA (USA)). 30 May 1985. Contract W-7405-ENG-48. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012913.

This report describes research results that have been obtained during the performance period 24 September 1984 to 23 September 1985. The tasks outlined in the work statement for this year have been completed, so this report is submitted now, and, in an accompanying proposal, request extended funding to perform additional work from 1 July until 30 September 1985. The fabrication of the vertical shock tube facility is complete. The 150 keV x-ray apparatus has been delivered and will be installed in the Guggenheim Laboratory by 15 June. In the remainder of this report some research results obtained in the horizontal shock tube are described, and briefly the new shock-tube facility is described.

41655 **(ZfK—601) Influence of a magnetic field on the diffusion of small particles in a turbulent flow.** Gerbeth, G.; Hamann, D. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). Aug 1986. 12p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702877.

The asymptotic diffusion coefficient tensor of suspended small particles in a turbulent flow is predicted. The contribution from the Basset history force in the equation of motion is investigated. Crossing trajectory effects are taken into account. The influence of a homogeneous external magnetic field on the diffusion coefficient is calculated for non-conducting suspended particles. The magnetic field is taken into account by its influence on the fluid velocity correlation tensor. The diffusion coefficient tensor is anisotropic due to the two preferred directions of the system, namely, the directions of the magnetic field and the deterministic particle velocity v/sub 0/. The obtained diffusion coefficients show an unexpected dependence on the parameter β = u/sub 0//v/sub 0/.

41656 **Studies of gasdynamic focusing in a near critically choked expansion.** Muenchausen, R.E.; Garcia, A.R.; Keller, R.A.; Nogar, N.S. (Chemistry Div., Los Alamos National Lab., Los Alamos, NM 87545). pp WA7.1-WA7.4 of Topical meeting on laser applications to chemical analysis (Technical Digest). Washington, DC; Optical Society of America (1987). (CONF-870119—).

From Topical meeting on laser applications to chemical analysis; Lake Tahoe, NV, USA (26 Jan 1987).

The authors have developed a technique well suited for gaseous flow field visualization using laser induced fluorescence (LIF) coupled with an array detector which allows us to obtain real-time spatial profiles of fluorescence from iodine seeded gas jets. Furthermore, array detection provides signals that are linear in fluorescence intensity as well as producing data ammenable to digital signal processing. A preliminary study by Keller and Nogar of photographically detected LIF demonstrated that a gas sample stream in a near critically choked expansion (P /sub source//P /sub chamber/ —2) could be focused by a gas sheath stream in a way directly analogous to hydrodynamic focusing in liquids. The authors have used our improved experimental apparatus to determine the range of source pressures and volume flow rates where this model of hydrodynamic focusing is applicable and to characterize the defocusing that occurs in the jet expansion region.

41657 **Visualization of flow fields and interfacial phenomena in liquid-liquid solvent extraction.** Scott, T.C. (Oak Ridge National Lab., TN). *Separation Science and Technology;* **22**: No. 2/3, 503-511(1987). (CONF-851011—). Contract AC05-84OR21400.

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

Use of a video camera apparatus with a helium-neon laser light source has enabled the detection of flow fields in and around a circulating aqueous droplet which is suspended in a flowing stream of 2-ethyl-1-hexanol. Droplet Reynolds numbers were in the range of 7 to 22. The behavior of the streamlines for flow both inside and outside the droplet was shown to be similar to that predicted for circulating droplets at low Reynolds numbers. Formation of stagnant caps of surfactant at the rear of the droplets was found to suppress the flow patterns inside the droplet and decrease the associated internal fluid velocities.

41658 **Continuous phase mixing on crossflow extraction sieve trays.** Eldridge, R.B.; Humphrey, J.L.; Fair, J.R. (Univ. of Texas, Austin). *Separation Science and Technology;* **22**: No. 2/3, 1121-1134(1987). (CONF-851011—).

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

Axial dispersion of a crossflowing continuous phase was studied in a special experimental system that simulated a slice from a large, commercial scale sieve tray extractor. The toluene-water system was used, and Peclet numbers were determined as functions of phase flow rates and tray geometry. It was concluded that for systems with relatively high interfacial tension, which give characteristically low point efficiencies, axial mixing is not an important issue in the design of sieve tray extractors.

41659 **Direct contact heat transfer.** Kreith, F.; Boehm, R. New York, NY; Hemisphere Publishing (1987). 275p. Hemisphere Publishing, 79 Madison Avenue, New York, NY 10016.

The author believes that because direct contact heat transfer research is growing rapidly, it is important to assess state-of-the-art knowledge in order to direct future progress. The direct contact approach to heat transfer can provide cost savings as well as thermodynamic efficiency - critically important factors in technologies using lower grade heat sources.

4205 Materials Testing

REFER ALSO TO CITATION(S) 40787, 40856, 41299, 42062, 42304

41660 **(DOE/ER/45112—4) Experiments and micromechanical models for creep-rupture in polymer matrix composites: Final technical report for period June 15, 1984-June 14, 1987.** Phoenix, S.L. (Cornell Univ., Ithaca, NY (USA). Sibley School of Mechanical and Aerospace Engineering). Jun 1987. Contract FG02-84ER45112. 76p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87011708.

The research thrust has been to develop micromechanical probability models and conduct critical experiments on the failure of polymer matrix composites under high, sustained loads. Tensile failure of such composites is a complex statistical process involving scattered failure of fibers at flaw sites, and local overloading and failure of neighboring fibers by way of stress transfer through the matrix which may creep and debond in time. Failure results from the subsequent development of a catastrophic crack. These models are ultimately to be used to develop life prediction methodologies, accelerated test techniques, and superior 'microengineered' composites. Recent theoretical progress has included a new recursive formulation which yields a key asymptotic scaling law for strength and lifetime; this is also a new development in modern percolation theory. A key characteristic distribution function results which embodies all local statistical and micromechanical activity, and is now amenable to 'supercomputer' calculation. Progress has also been made in developing a self-similar formulation for micromechanical stress redistribution under a power law creeping matrix. Experimental advances include (1) creep-rupture results for single Kevlar 49 aramid fibers at elevated temperatures, (2) creep-rupture results

for graphite fiber/epoxy microcomposites, (3) the development of a single fiber composite test as an advanced technique for studying statistics for fiber strength and fiber/matrix debonding, (4) microindentation techniques for studying matrix creep and debonding, and (5) the development of research equipment for high-precision fabrication of microcomposites.

41661 **(INIS-mf—10667) Austenite testing: Prototype device for improved flaw detection by ultrasonic testing of coarse-grained austenitic materials, using combined signal matching methods. Construction of test problem-specific SEL angular test heads.** August, W.; Matthies, K.; Neumann, E. (Bundesanstalt fuer Materialpruefung, Berlin (Germany, F.R.)). 1986. 77p. (In German). NTIS, PC E09; Available from NTIS as TIB/B87-09334.

The report explains the ways an ultrasonic signal is influenced by the structural conditions in the austenitic weld, and the consequences to be drawn for practical testing. For reasons of comparison, suitable test specimens of pure austenitic welds are examined for their acoustic properties.

41662 **(NRCN(TN)—106) Adaption of a smelting furnace to immersion experiments of solid metals in liquid metals.** Kuznietz, M.; Gazit, D.; Erez, G. (Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev). Jun 1986. 15p. (In Hebrew). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702856.

The adaption of existing smelting furnace, to immersion experiments of solid metals in liquid metals, is described. The modifications include a Wilson seal, a stainless-steel feed-through, to which a molybdenum rod is adjoined with a metal sheet made in the form of a cylinder or a scoop attached to the latter by means of a tantalum wire. The metal sheet is immersed, in a controlled way, in the liquid metal which is contained in a magnesia-stabilized zirconia crucible held in a protective graphite crucible. The results of a few immersion experiments are given.

41663 **(NUREG/CR—4952) Experimental study of fillet weld undercut effects on welded tubing structures under centric and eccentric cyclic loading, June 1985-February 1986.** Okaily, A.A. (Franklin Research Center, Philadelphia, PA (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Emergency Preparedness and Engineering Response). Jun 1987. 82p. NTIS, PC A05/MF A01 - GPO. File Number TI87900901.

The effects of weld undercut defects on the permanent deflection, weld stresses at failure, and ultimate load of twelve welded tubing test specimens subjected to centric and eccentric cyclic loading were evaluated. The test program included the design, fabrication, and testing of one group of six fillet-welded tubing specimens and one group of six reinforced partial-penetration, groove-welded tubing specimens. Each group consisted of three centrically loaded specimens with 0-, 1/32-, and 1/16-in. undercuts and three eccentrically loaded specimens with 0-, 1/32-, and 1/16-in. undercuts. Permanent deflection, d, was recorded after 1, 5, and 10 load cycles at 10% increments of the calculated yield load, P/sub Y/, starting at 50% P/sub Y/, through the ultimate load, P/sub u/. Permanent deflection ratios, d/d/sub o/, of a defective specimen versus that of a similar, but sound specimen (i.e., no undercutting) at the same load level and number of cycles were then calculated. Analysis of test results led to several conclusions related to the effects of fillet weld undercut on permanent deflection ratios, weld stresses at failure, and ultimate load values of welded tubing structural members under centric and eccentric cyclic loading.

41664 **(SAND—86-2924C) Repetitively pulsed vacuum insulator flashover.** Ginn, J.W.; Buttram, M.T. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 16p. (CONF-870656—8). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011196.

From 6. Institute of Electrical and Electronic Engineers pulsed power conference; Arlington, VA, USA (29 Jun 1987).

Experiments were performed to determine the flashover strength of various vacuum insulators under conditions of repetitive pulsing. The pulse duration was 30 ns, and the thickness of a typical insulator sample was 1.8 cm. Data were taken for 45° insulators from five different materials. An insulator was subjected to an extended series of pulses at a given repetition rate and field. If flashover was not detected, the field level was increased and the sequence repeated. At rates up to 50 pulses per second, there was no apparent dependence of flashover field on rate. In addition, some "single shot" data were taken, including various modifications of the geometries and surface textures of the insulators. Only two to the modifications increased the flashover strength significantly over that of a 45° sample: (1) annealing some plastics (roughly a 35% increase), and (2) extending the insulator to cover the surfaces of both electrodes (an increase of nearly a factor of two).

4208 Electronic Circuits And Devices

REFER ALSO TO CITATION(S) 41377, 41399, 41417, 41635, 41733, 41839

41665 **(FNAL-TM—1453) The MADC (Multiplexed ADC): How to make connections to it?.** Seino, K.C. (Fermi National Accelerator Lab., Batavia, IL (USA)). May 1987. Contract AC02-76CH03000. 16p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87010297.

Questions on a Multiplexed Analog-to-Digital converter (MADC) are answered. Topics covered are: Input Cables and Convections; Source Impedance; MADC Input Impedance; MADC Specifications. (LSP)

41666 **(LA—11044-T) The mathematical modeling of time-dependent photoconductive phenomena in semiconductors.** Iverson, A.E. (Los Alamos National Lab., NM (USA)). Jul 1987. Contract W-7405-ENG-36. 163p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE87012049.

This dissertation presents results pertaining to the mathematical modeling of semiconductor photoconductors and includes the formulation, analysis, and solution of photoconductive device model equations. The fundamental semiconductor device equations of continuity and transport are derived for the case of a material which contains a large density of deep-level impurities. Electron and hole trapping on deep-level impurities is accounted for by trapping-kinetics rate equations. The coupling between carrier drift and the electric field is completed through Poisson's equation. Simple, nonlinear model equations are presented for bulk-material response based on the dynamics of electron and hole trapping and recombination on deep-level impurities. The characteristics of the solution to these model equations are observed to depend strongly on the excitation intensity. These model equations qualitatively reproduce observed experimental behavior of an iron-doped indium phosphide photoconductor. A theory of the effect of deep-level centers on the generation-recombination noise and responsivity of an intrinsic photoconductor is presented. Photoconductive device model equations based on time-dependent, convective/diffusive transport equations are presented. The system of model equations is solved numerically with boundary conditions that represent ideal ohmic contacts. Computed results are presented for different photoconductor lengths and bias voltages with spatially uniform, rectangular light-pulse illumination.

41667 **(LA-UR—87-2101) Advances in explosively formed fuse opening switches.** Goforth, J.H.; Caird, R.S.; Greene, A.E.; Lindemuth, I.R.; Marsh, S.P.; Oona, H.; Reinovsky, R.E. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 9p. (CONF-8706155—1). NTIS, PC A02. File Number DE87011761.

From 6. IEEE pulsed power conference; Washington, DC, USA (29 Jun 1987).

The development of Explosively Formed Fuses along two separate lines is discussed. One design, which has previously been demonstrated to conduct a 9.5 MA 350 μs risetime pulse and interrupt it in 1.2 μs. This scaled up design should operate at up to 15 MA with 20 nH loads. A second design with enhanced performance characteristics is being examined and will be tested on a small scale. This design includes opening switch inductance as part of the inductive store and, as a result, should have shorter pulse transfer times and should be able to be scaled to handle currents up to ~ 25 MA with 20 nH loads.

41668 **(LA-UR—87-2138) Optimum size of staged flux compression generators.** Vorthman, J.E. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 4p. (CONF-870656—22). NTIS, PC A02. File Number DE87011741.

From 6. Institute of Electrical and Electronic Engineers pulsed power conference; Arlington, VA, USA (29 Jun 1987).

This paper presents the results of an investigation to determine when two small transformer coupled flux compression generators are better than one large generator. The system considered consists of a helical flux compression generator transformer coupled to an inductive load. The question is then whether the system energy gain (final load energy divided by initial system energy) would be greater if the generator were split in half and a transformer used to connect the pieces. For the lossless case, this problem has been solved exactly in terms of the transformer k factor and the initial and final generator inductances. An approximate solution which assumes a simple loss model is also discussed.

41669 **(SAND—87-0279C) Development of a repetitive 1-MV, 22-kJ Marx generator.** O'Malley, M.W.; Buttram, M.T. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 4p. (CONF-870656—9). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011286.

From 6. Institute of Electrical and Electronic Engineers pulsed power conference; Arlington, VA, USA (29 Jun 1987).

A 220-kW Marx generator has been designed, built, and tested. It was developed to drive several different pulse power experimental devices requiring repetitive pulses at voltages to 1 MV and energies to 22 kJ per pulse. Experiments are planned that will explore dielectric performance under repetitive stress, cold cathode diode operation, and repetitive switching with saturable inductors at moderate peak power and voltage. A Marx generator was chosen because it has the versatility to drive such a variety of loads. The Marx generator system is made of 16 inductively isolated capacitor stages resistively charged to a maximum of 62.5 kV per capacitor and eight gas dynamic spark gaps. The charging source is a 2-MW dc bipolar power supply. The gas purging system is capable of supplying 3500 SCFH of air at the required pressure. The first two spark gaps of the Marx generator are triggered with a grounded grid thyratron pulser through a 1:10 step-up transformer with an output peaking gap as an (unused) option. At the maximum output (1 MV, 22 kJ) a repetition rate of 10 Hz is possible. This paper will review some of the development work done on rep rated Marx generators as well as explain the present Marx generator configuration and associated hardware systems.

41670 **(SAND—87-1698C) Dielectric modification of repetition-rate tested polycarbonate-perfluorocarbon capacitors: The G.H. Mauldin memorial report.** Mauldin, G.H.; Thompson, M.C.; Somoano, R.B.; Yen, S.P.S.; Harris, J.O.; Schreiner, E.T. (Sandia National Labs., Albuquerque, NM (USA); Los Alamos National Lab., NM (USA); Jet Propulsion Lab., Pasadena, CA (USA)). 1987. Contract AC04-76DP00789. 11p. (CONF-870656—7). NTIS, PC A02. File Number DE87011306.

From 6. Institute of Electrical and Electronic Engineers pulsed power conference; Arlington, VA, USA (29 Jun 1987).

It appears the operational life of a perfluorocarbon-impregnated capacitor is a strong function of the crystalline-amorphous character of the polycarbonate (PC) dielectric material. X-ray diffraction studies and thermomechanical analysis (TMA) of the material at the Jet Propulsion Laboratory, Pasadena, California, have shown new enlightening information. Gas Studies of the impregnate solution have also yielded new answers. Discussed is the dynamics of both the ESR (equivalent series resistance) and the equivalent dynamic capacitance of an in-situ device as observed during testing at the Los Alamos National Laboratory's test facility.

41671 **(UCID—21095) Impedance effects on electromagnetic susceptibility.** Ng, W.C.; King, R.J. (Lawrence Livermore National Lab., CA (USA)). Jun 1987. Contract W-7405-ENG-48. 33p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011900.

This report studies the impedance effects on electromagnetic susceptibility for various loading conditions. From measurements of the self-impedance (Z/sub A/) and received voltage across 50 ohms at the terminals of a generic test object, a Thevenin equivalent circuit model is derived. Then, using this model, the load voltage, current, spectral energy density and accumulated energy are computed for several interesting load impedances. Of interest are two worst cases where the load impedance is the complex conjugate of Z/sub A/ and the conjugate pure reactance of Z/sub A/. Another case of particular interest is where the load impedance is that of an electronic unit representing that of a typical subsystem designed for operation at much lower frequencies. These three cases are compared with the voltage, current and energy at a 50 ohm load. It is concluded that the load voltage, current, spectral energy density and accumulated energy of the two conjugate cases can be one or two orders of magnitude larger than that for the 50 ohm case as might be expected. However, load voltage, current, and spectral energy density at the input of the electronic units tested are comparable to that of the 50 ohm case. The spectral energy density responses are generally within a factor of two (+-3 dB), but may be as large as a factor of three (+-5 dB) over narrow frequency bands.

41672 **(UCRL—96203) Evaluation of commercially available ignitrons as high-current, high-Coulomb transfer switches.** Kihara, R. (Lawrence Livermore National Lab., CA (USA)). 29 Jun 1987. Contract W-7405-ENG-48. 6p. (CONF-870656—17). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011883.

From 6. Institute of Electrical and Electronic Engineers pulsed power conference; Arlington, VA, USA (29 Jun 1987).

New or improved switches are needed to meet the power requirements of multimegajoule glass laser Inertial Confinement Fusion (ICF) systems and Strategic Defense Initiative (SDI) weapons (e.g., mass drivers, railguns, and high-powered pulse lasers). These devices must switch high peak currents ($>1 \times 10^6$ A) and voltages (>20 kV), with an initial rate of current rise (di/dt) greater than 15 kA/μs, while transferring large quantities of charge ($>10^3$ C/pulse). The generated pulse will typically have a pulse width of 0.5 to 1.0 ms, measured at the Full-Width Half-Maximum (FWHM) or the 50% amplitude points of the waveform. The simultaneous attainment of these parameters in a reparable switch has not yet been attained. An evaluation of commercially available ignitrons has been performed. All of tubes tested showed a rapid drop in ignitor resistance with time. Without the use of a high energy pulser to clear the ignitors, the tube lifetimes given in this report would have been substantially shorter. The performance of the size "E" ignitrons was disappointing in comparison to the performance of the size "D," as the specifications of the "E" size, along with their greater physical size and mass, would tend to imply a similarly scaled capacity. Although the lifetested size "D" tube survived half as long as the size "E" tubes, the failure was mechanical in nature, and had the tube been physically stronger, we feel it would have matched the size "E" tubes in performance.

41673 **Reliable, low-profile banding of electrical leads in high-vacuum systems.** Fowler, G.L. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **5**: No. 5, 2978-2978(Sep 1987). Contract AC04-76DP00789.

This article describes a very reliable method of securely banding electrical leads to the circumference of a substrate for ultrahigh vacuum applications in which mechanical support and/or electrical insulation are necessary. Its minimal increase to the overall diameter of the substrate (low profile) makes it very convenient to use in confined places.

41674 **Planarization of metal films for multilevel interconnects by pulsed laser heating.** Tuckerman, D.B. (to Dept. of Energy, Washington, DC). US Patent 4,674,176. 23 Jun 1987. Filed date 24 Jun 1985. vp.

A method is described of fabricating an integrated circuit structure having a thin metal layer deposited on an insulating layer or substrate. The step of planarizing the metal layer by heating to momentarily melt the layer for a time sufficient to substantially eliminate topographic variations of less than a preselected spatial period produces a flat surface on the metal layer without reacting

or alloying the metal layer with the insulating layer or substrate. The planarizing occurs prior to patterning the layer.

41675 **(OA-Trans—2819) Electrical and environmental artificial accelerated ageing test on optical cable for data transmission with a self-supporting resin-glass structure.** (Overseas Relations Branch Translation Service, London (UK); Ente Nazionale per l'Energia Elettrica, Milano (Italy). Centro di Ricerca Elettrica). Mar 1987. Translation of Report No. 410.280/6, March 1985. 39p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87900905.

The chief purpose of the test was to obtain, in a relatively short time, indications of the behavior and any degradation of the optical cable in service. The test was substantially derived from that proposed at CIGRE to represent the long-term behavior of insulators composed of organic material. It consisted of the repetition - over a pre-determined total period of time - of the ageing cycle of a week's duration. This cycle involved the principal environmental stresses, such as contamination, rain, solar radiation and temperature variations. Part of the optical cable was also subjected to the action of an electrical field of the order of those produced on the cable by the conductors of the transmission line on which it may be installed. Another part was subjected to a mechanical tensile load to represent the pulling stress on the cable in service. The ageing test was subdivided into two consecutive periods, each of 1000 hours duration. In the first period, a 500 m length of optical cable was tested. In the second period, two lengths were tested, each 20 m long and taken from a length of cable which remained intact after passing the first test period. The test configurations are described and the results are reported. 1 ref., 21 figs., 4 tabs.

4209 Waste Processing Plants And Equipment

41676 **(HPM—85-047) Industrial hygiene review of HWI basic data draft.** Pell, R.W. (Savannah River Lab., Aiken, SC (USA)). 19 Apr 1985. Contract AC09-76SR00001. 2p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012215.

This memo recommends changes in the construction of facilities for disposing of benzene containing wastes by incineration. (TEM)

4210 Combustion Systems

REFER ALSO TO CITATION(S) 40407, 40408, 40779, 40782, 41644, 41926

41677 (AGARD-CP—99, pp vp) **Tip clearance measurement in modern compressor components.** Knoell, H.; Ding, K. Nov 1986. NTIS, PC A24/MF A01. (CONF-8605280—).

From Advanced instrumentation for aero engine components conference; Philadelphia, PA, USA (19 May 1986).

With regard to maximum efficiency of gas turbine compressors, small blade tip clearances during all engine operating conditions should be achieved. In order to determine the tip clearance during compressor tests, a reliable measuring technique has been developed. Using this temperature-insensitive capacitive probe system (Coulomb system), tip clearance can be monitored even during fast transient conditions. The sensors of the multichannel equipment can operate up to high temperature without cooling. Application to compressor testing is described in two examples; a high-speed centrifugal compressor rig and the intermediate-pressure compressor of a jet engine.

41678 (INIS-mf—10706, pp 1-23) **Fluidized-bed combustion technology for power plants.** Wein, W. (Stadtwerke Duisburg A.G., Germany, F.R.). 1986. (In German). NTIS (US Sales Only), PC A16/MF A01. File Number DE87752788. (CONF-8605275—).

From VGB special meeting on Yugoslavia; Bled, Yugoslavia (14 May 1986).

Fluidized-bed combustion (FBC) features several advantages including possible methods for pollutant reduction during the combustion process and the application of a broad range of fuels. The author deals with FBC associated with various firing systems like grid firing, dust firing, etc. while focussing on the description of FBC systems, their technologies, their state of the art and development potentials. In conclusion, the author gives a list of existing plants equipped with different FBC systems. (HAG).

41679 (INIS-mf—10706, pp 1-11) **Mathematical models for the determination of the effectiveness of the cleaning of firing system heating surfaces.** Gulic, M. 1986. (In German). NTIS (US Sales Only), PC A16/MF A01. File Number DE87752788. (CONF-8605275—).

From VGB special meeting on Yugoslavia; Bled, Yugoslavia (14 May 1986).

The author deals with the problem of firing-system heating-surface fouling. This is a major concern in Yugoslavia since its utilities increasingly use coals of a higher ash content whose poor chemical and physical properties often accelerate the fouling processes at firing-system heating surfaces thus reducing the availability and service life of power plants. The author presents the method for determining the temporal heat-transfer-resistance changes of ash deposits on heating surfaces in the interval between two cleaning cycles and for prolonged time periods by means of a mathematical model of the combustion heat calculation and by relatively few measurements which can be performed by plant staff in most cases. The data from this method can be used for determining the effectiveness of available equipment for cleaning the heating surfaces in order to select the best cleaning method and, in particular, to determine the real values for the input variables of heat calculations for planned new firing systems. The author presents all details required for the implementation of such measurements which may be useful both for operation and for the analysis of design approaches in dependence from fuel properties and the conditions of steam boiler function.

4220 Underground Engineering

REFER ALSO TO CITATION(S) 40561

4240 Pollution Control Equipment

REFER ALSO TO CITATION(S) 40323, 40790, 40792, 41901

41680 (SAAS—342, pp 46-54) **Monitoring of filter equipment retaining radioactive aerosols from the air.** Hamel, P. 1986. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE87780154. (CONF-8509389—Pt.2).

From Final conference on scientific-technological cooperation between the MoH of the USSR and the SAAS of the GDR; Tashkent, USSR (2 Sep 1985).

The system of state and internal monitoring to secure the reliable function of aerosol filter equipment is described, especially the control conception applied, their components of measurement engineering as well as the duties derived from the further development. A judgement of the present stage of development of filter production and of the sources of errors possibly influencing the function of filter equipments and the quality of control measurements is given.

41681 **(SAAS—342) Final conference on scientific-technological cooperation in the field of radiation protection between the MoH and the SAAS from 1981 to 1985. Part 2.** (Staatliches Amt fuer Atomsicherheit und Strahlenschutz, Berlin (German Democratic Republic)). 1986. vp. (In German). (CONF-8509389—Pt.2). NTIS (US Sales Only), PC A04/MF A01. File Number DE87780154.

From Final conference on scientific-technological cooperation between the MoH of the USSR and the SAAS of the GDR; Tashkent, USSR (2 Sep 1985).

Seperate abstracts wre prepared for the individual papers in this report. (JDB)

4250 Power Cycles

41682 (PNL—6278) Heat engine regenerators: Research status and needs. Hutchinson, R.A. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1987. Contract AC06-76RL01830. 67p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87013581.

The rapidly oscillating, variable density flows of regenerative heat engines provide a class of poorly understood unsteady flow and heat transfer problems. These problems are not currently amenable to direct experimental resolution. Experiences in engine development and test programs and efforts to develop analysis tools point to the regenerator as a key area of insufficient understanding. Focusing on flow and heat transfer in regenerators, this report discusses similarity parameters for the flows and reviews the experimental data currently available for Stirling analysis. Then a number of experimental results are presented from recent fundamental fluid mechanical and thermal investigations that shed additional light on the functioning of heat engine regenerators. Suggestions are made for approaches for further measurement and analysis efforts.

43 PARTICLE ACCELERATORS

REFER ALSO TO CITATION(S) 42883

41683 (CERN—87-01) CAS CERN Accelerator School: Applied geodesy for particle accelerators. Proceedings. Turner, S. (ed.). (European Organization for Nuclear Research, Geneva (Switzerland)). 9 Feb 1987. 423p. (CONF-860462—). NTIS (US Sales Only), PC A18/MF A01. File Number DE87702667.

From Applied geodesy for particle accelerators; Geneva, Switzerland (14 Apr 1986).

This specialized course addresses the many topics involved in the application of geodesy to large particle accelerators, though many of the techniques described are equally applicable to large construction projects and surveillance systems where the highest possible surveying accuracies are required. The course reflects the considerable experience gained over many years, not only at CERN but in projects all over the world. The methods described range from the latest approach using satellites to recent developments in conventional techniques. They include the global positioning system (GPS), its development, deployment and precision, the use of the Terrameter and the combination or comparison of its results with those of the GPS, the automation of instruments, the management of measurements and data, and the highly evolved treatment of the observations.

4301 Design, Development, And Operation

REFER ALSO TO CITATION(S) 41627, 41834, 42438, 42801, 42802, 42803, 42805

41684 (ANL-HEP-CP—87-14) Mixing, staging, and phasing for a proton-driven wake field accelerator. Gai, W.; Ruggiero, A.G.; Simpson, J.D. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 4p. (CONF-870302—214). NTIS, PC A02. File Number DE87011513.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

This paper expands on a few important details of the Wakeatron concept. This is a device where electrons can be accelerated by the wake field of short intense proton bunches travelling along the axis of an rf structure. Specifically, we have examined the consequences of the longitudinal dynamics of both the electron and the proton bunches. Included were "mixing" in the proton bunches (crucial to the overall concept) and phase shifts (electron bunches relative to proton bunches) in the acceleration process. Because of the deterioration of the proton bunches, due to the "mixing" process, it is required that the Wakeatron is indeed staged in a number of consecutive sections.

41685 (CEA-CONF—8743) Preliminary study of a superfluid helium cryogenic system for the large hadron collider. Claudet, G.; Disdier, F.; Lebrun, P.; Morpurgo, M.; Veymuth, P. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Recherche Fondamentale). May 1986. 7p. (CONF-860583—7). NTIS (US Sales Only), PC A02. File Number DE87751633.

From International Committee for Future Accelerators workshop on superconducting magnets and cryogenics; Upton, NY, USA (12 May 1986).

This paper reports on a preliminary study to assess the feasibility of a large hadron collider with dipoles cooled at He II temperature in the LEP tunnel at CERN. 10 T NbTi dipoles have to be cooled near 1.8 K taking into account the constraints and the boundary conditions of an existing tunnel (tunnel size, access pits, etc.). This first approach gives an estimation of the heat load and energy consumption. Possible solutions and associated circuitry are analysed and discussed in the case of the main operating modes resulting from the collider operation.

41686 (CONF-870302—211) Present and future superconducting linacs. Bollinger, L.M. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 7p. NTIS, PC A02. File Number DE87011500.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

This paper is a survey of superconducting linacs designed for heavy-ion acceleration and a brief discussion of future prospects. Eight such machines are in operation or under construction, and others are being planned. Most of these linacs function as energy boosters for ions from tandem electrostatic accelerators and are designed to provide output beams of relatively low energy but very good quality. The short independently-phased accelerating structures of the linacs involved in these tandem-linac systems cover the velocity range $0.04 \leqq \beta \leqq 0.3$. In a recent development, the technology is being extended down to ions with $\beta < 0.01$ in order to eliminate the need for the tandem injector. The main design features of the various heavy-ion linacs are summarized, and differences from superconducting linacs for electron acceleration are noted.

41687 (DOE/ER/40150—11) The CEBAF [Continuous Electron Beam Accelerator Facility] cryogenic system. Brindza, P.; Rode, C. (Continuous Electron Beam Accelerator Facility, Newport News, VA (USA)). 1986. Contract AC05-84ER40150. 6p. (CEBAF-PR—86-005; CONF-860629—76). NTIS, PC A02. File Number DE87008660.

From Linear accelerator conference; Stanford, CA, USA (2 Jun 1986).

This report describes the cryogenics system for CEBAF which consists of a 5kW central helium refrigerator and a transfer line system to supply 2.2 K 2.8 ATM helium to the cavity cryostats, 40 K helium at 3.5 ATM to the radiation shields and 4.5K helium at 2.8 ATM to the superconducting magnetic spectrometers in the experimental halls. Both the 2.2K and the 4.5K helium are expanded by Joule-Thompson (JT) valves in the individual cryostats yielding 2.0K at .031 ATM and 4.4K at 1.2 ATM respectively. The Central Helium Refrigerator is located in the center of the CEBAF racetrack with the transfer lines located in the linac tunnels.

41688 (DOE/ER/40150—14) The CEBAF [Continuous Electron Beam Accelerator Facility] superconducting accelerator cryomodule. Biallas, G.; Brindza, P.; Rode, C.; Phillips, L. (Continuous Electron Beam Accelerator Facility, Newport News, VA (USA); Cornell Univ., Ithaca, NY (USA)). Jun 1986. Contract AC05-84ER40150. 6p. (CEBAF-PR—86-010; CONF-860629—75). NTIS, PC A02. File Number DE87008661.

From Linear accelerator conference; Stanford, CA, USA (2 Jun 1986).

The design and fabrication of the cavity enclosure and calculation to support the 2°K operating temperature, and techniques for minimizing operating heat loads and cryostat loads are discussed. The integrating of the Cryogen fluid distribution system into the cavity cryostat will be presented. Integration of the cavity design

into cavity fabrication and maintenance program, with emphasis on system reliability and flexibility, is included.

41689 **(DOE/ER/40150—21) Electron accelerators for research at the frontiers of nuclear physics.** Grunder, H.A.; Hartline, B.K.; Corneliussen, S.T. (Continuous Electron Beam Accelerator Facility, Newport News, VA (USA)). 1986. Contract AC05-84ER40150. 24p. (CEBAF-PR—87-001; CONF-8610239—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87008669.

From Symposium celebrating 35 years of electron scattering in nuclear and particle science; Urbana, IL, USA (23 Oct 1986).

Electron accelerators for the frontiers of nuclear physics must provide high duty factor (>80%) for coincidence measurements; few-hundred-MeV through few-GeV energy for work in the nucleonic, hadronic, and confinement regimes; energy resolution of $\sim 10^{-4}$; and high current (≅ 100 μA). To fulfill these requirements new machines and upgrades of existing ones are being planned or constructed. Representative microtron-based facilities are the upgrade of MAMI at the University of Mainz (West Germany), the proposed two-stage cascaded microtron at the University of Illinois (USA), and the three-stage Troitsk "polytron" (USSR). Representative projects to add pulse stretcher rings to existing linacs are the upgrades at MIT-Bates (USA) and at NIKHEF-K (Netherlands). Recent advances in superconducting rf technology, especially in cavity design and fabrication, have made large superconducting cw linacs become feasible. Recirculating superconducting cw linacs are under construction at the University of Darmstadt (West Germany) and at CEBAF (USA), and a proposal is being developed at Saclay (France). 31 refs.

41690 **(EFI—832(59)-85) Acceleration of charged particles by strong longitudinal plasma wake fields excited by electron bunches.** Amatuni, A.Ts.; Elbakyan, S.S.; Sekhpossyan, E.V. (Erevanskij Fizicheskij Inst. (USSR)). 1985. 14p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702683.

The possibility of the use of longitudinal field excited in a plasma by electron bunches to accelerate charged particles is investigated. It is shown that the highets value of accelerating fields proportional to the square root of factor of electrons in the bunch is achieved in the case when bunch particle density approaches a limit equal to the half of the the plasma electron equilibrium density. 13 references.

41691 **(FNAL-TM—1454) 1987 DOE review: First collider run operation.** Childress, S.; Crawford, J.; Dugan, G.; Edwards, H.; Finley, D.A.; Fowler, W.B.; Harrison, M.; Holmes, S.; Makara, J.N.; Malamud, E. (Fermi National Accelerator Lab., Batavia, IL (USA)). May 1987. Contract AC02-76CH03000. 69p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87010295.

This review covers the operations of the first run of the 1.8 TeV superconducting super collider. The papers enclosed cover: PBAR source status, fixed target operation, Tevatron cryogenic reliability and capacity upgrade, Tevatron Energy upgrade progress and plans, status of the D0 low beta insertion, 1.8 K and 4.7 K refrigeration for low-β quadrupoles, progress and plans for the LINAC and booster, near term and long term and long term performance improvements.

41692 **(GSI—87-17-Prepr.) Physics and present status of the GSI-SIS/ESR project.** Kienle, P. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Apr 1987. 13p. (CONF-870413—5-Prepr.). NTIS, PC E07; Available from NTIS as TIB/B87-09393.

From 11. international conference on particles and nuclei; Kyoto, Japan (20 Apr 1987).

The author describes the relativistic heavy ion projects at the GSI Darmstadt. After a short description of the accelerator facilities the study of intermediate-energy heavy ion reactions, the production of radioactive ion beams, and some proposed nuclear physics experiments are discussed. Finally the production of a crystalline beam structure by cooling beams of highly stripped high Z ions is briefly considered together with applications to high precision mass measurement and laser spectroscopy. (HSI).

41693 **(JINR—9-86-305) Results of tune-up period on the ITs-100 heavy ion cyclic implantator.** Boltushkin, V.V.; Bogomolov, S.L.; Gul'bekyan, G.G.; Ivanenko, A.I.; Morduev, A.M.; Oganesyan, R.Ts. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1986. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702815.

The tune-up period of IC-100 cyclic implantator has been completed. The ion beams from $^{12}C^{+2}$ upto $^{40}Ar^{+7}$ have been accelerated with 1 MeV/nucleon energy and $7.5x10^{13}$-$1x10^{12}$ s^{-1} intensities. The cyclotron magnetic field has been formed with a high accuracy by means of iron blocks only without current correction. The axial penning ion source was used on the cyclotron. The RF generator of 25 kW power was used as a RF voltage source. The main characteristics of the resonance system, vacuum system and main parameters of the cyclotron and ion beams are presented, as well as the dependences of the beams on variation of the cyclotron main parameters are given. 3 references, 7 figures.

41694 **(LBL—21519) Ground motion measurements at the LBL Light Source site, the Bevatron and at SLAC.** Green, M.A.; Majer, E.I.; More, V.D.; O'Connell, D.R.; Shilling, R.C. (Lawrence Berkeley Lab., CA (USA)). Dec 1986. Contract AC03-76SF00098. 94p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87010746.

This report describes the technique for measuring ground motion at the site of the 1.0 to 2.0 GeV Synchrotron Radiation Facility which was known as the Advanced Light Source (in 1983 when the measurements were taken). The results of ground motion measurements at the Light Source site at Building 6 at LBL are presented. As comparison, ground motion measurements were made at the Byerly Tunnel, the Bevatron, Blackberry Canyon, and SLAC at the Spear Ring. Ground Motion at the Light Source site was measured in a band from 4 to 100 Hz. The measured noise is primarily local in origin and is not easily transported through LBL soils. The background ground motion is for the most part less than 0.1 microns. Localized truck traffic near Building 6 and the operation of the cranes in the building can result in local ground motions of a micron or more for short periods of time. The background motion at Building 6 is between 1 and 2 orders of magnitude higher than ground motion in a quiet seismic tunnel, which is representative of quiet sites worldwide. The magnitude of the ground motions at SLAC and the Bevatron are comparable to ground motions measured at the Building 6 Light Source site. However, the frequency signature of each site is very different.

41695 **(LBL—22243) The Bevatron liquid nitrogen circulation system.** Hunt, D.; Stover, G. (Lawrence Berkeley Lab., CA (USA)). Mar 1987. Contract AC03-76SF00098. 6p. (CONF-870302—186). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010256.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

A nitrogen liquefier and computer controlled valving system have been added to the Bevatron cryoliner vacuum system to cut operating costs by reducing liquid nitrogen consumption. The computer and interface electronic systems, which control the temperatures of twenty-eight liquid nitrogen circuits, have been chosen and designed to operate in the Bevatron's pulsating magnetic field. The nitrogen exhaust is routed back to a liquefier, of about five kilowatt capacity, liquefied, and rerouted through the cooling circuits. A description of the system and operating results are presented.

41696 **(LBL—23324) Status of the Berkeley small cyclotron AMS [accelerator mass spectrometry] project.** Bertsche, K.J.; Friedman, P.G.; Morris, D.E.; Muller, R.A.; Welch, J.J. (Lawrence Berkeley Lab., CA (USA)). Apr 1987. Contract AC03-76SF00098. 15p. (CONF-8704112—7). NTIS, PC A02/MF A01; GPO Dep. File Number DE87011215.

From 4. international symposium on accelerator mass spectrometry; Ontario, Canada (27 Apr 1987).

A small, low-energy cyclotron has been designed and built at Berkeley for direct detection dating of ^{14}C. The system combines the use of a negative ion source to reject ^{14}N with the high resolution of a cyclotron to reject other background ions. In order

to allow the dating of old and small samples, the present system incorporates a high-current external ion source and injection beamline. The system is expected to be operational by mid-1987.

41697 **(SAND—87-0018C) The PT1 linear induction accelerator.** Stinnett, R.W.; Buttram, M.T.; Ginn, J.W.; Hamil, R.A.; Harjes, H.C.; Lancaster, K.T.; Loubriel, G.M.; Poukey, J.W.; Rohwein, G.J.; Zutavern, F.J. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 14p. (CONF-870656—6). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011310.

From 6. Institute of Electrical and Electronic Engineers pulsed power conference; Arlington, VA, USA (29 Jun 1987).

A concept for a compact, modular, linear induction accelerator has been developed which demonstrates the technology required to produce long bursts of short (20 ns FWHM), closely spaced, relatively high current (1 kA), electron beam pulses. A Photoconductive Semiconductor Switch (PCSS) System is used to produce trains of short pulses directly from the output of a long pulse transformer. The average gradient of this accelerator will be 1.6 MV/m.

41698 **(SLAC-PUB—4176) Analysis of optical perturbations of the SLC arcs.** Weng, W.T.; Sands, M. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Jan 1987. Contract AC03-76SF00515. 4p. (CONF-870302—181). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009891.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

This paper establishes the analytical framework in solving optical pertubations in a transport line in general and the SLC Arc specifically. The Formulation presented here is applicable to any transport system in a straightforward way. The equations of motion of a perturbed betatron function and dispersion function are presented. Sources of field errors for the SLC Arc system are discussed. Magnitudes of pertubations to the optical functions for the SLC Arc are estimated. (JDH)

41699 **(SLAC-PUB—4187) Channeled particle acceleration by plasma waves in metals.** Chen, P.; Noble, R.J. (Stanford Linear Accelerator Center, Menlo Park, CA (USA); Fermi National Accelerator Lab., Batavia, IL (USA)). Jan 1987. Contract AC03-76SF00515. 5p. (SLAC/AP—55; CONF-8603114—4). NTIS, PC A02/MF A01; GPO Dep. File Number DE87010541.

From Workshop on relativistic channeling Acquafredda di Maratea; Maratea, Italy (31 Mar 1986).

A solid state accelerator concept utilizing particle acceleration along crystal channels by longitudinal electron plasma waves in a metal is presented. Acceleration gradients of order 100 GV/cm are theoretically possible. Particle dechanneling due to electron multiple scattering can be eliminated with a sufficiently high acceleration gradient. Plasma wave dissipation and generation in metals are also discussed.

41700 **(SLAC-PUB—4310) Rf-driver linear colliders.** Wilson, P.B. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). May 1987. Contract AC03-76SF00515. 7p. (CONF-870302—198). NTIS, PC A02. File Number DE87010314.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The next generation of linear collider after the SLC (Stanford Linear Collider) will probably have an energy in the range 300 GeV-1 TeV per linac. A number of exotic accelerating schemes, such as laser and plasma acceleration, have been proposed for linear colliders of the far future. However, the technology which is most mature and which could lead to a collider in the above energy range in the relatively near future is the rf-driven linac, in which externally produced rf is fed into a more or less conventional metallic accelerating structure. Two basic technologies have been proposed for producing the required high peak rf power: discrete microwave power sources, and various two-beam acceleration schemes in which the rf is produced by a high current driving beam running parallel to the main accelerator. The current status of experimental and analytic work on both the discrete source and the two-beam methods for producing rf is discussed. The implications of beam-beam related effects (luminosity, disruption and beamstrahlung) for the design of rf-driven colliders are also considered.

41701 **(SLAC-PUB—4326) Status of the SLC [SLAC Linear Collider].** Moffeit, K.C. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Apr 1987. Contract AC03-76SF00515. 13p. (CONF-870390—8). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011594.

From 22. Recontres de Moriond: electroweak interactions and unified theories conference; Les Arcs, France (8 Mar 1987).

A short review of the physics goals and the status of the SLC is followed by a discussion of the energy spectrometer with center-of-mass energy resolution on a pulse-to-pulse basis of +-50 MeV/c^2. The status of the SLC polarization experiment is discussed. The expected physics program of the Mark II is given.

41702 **RF linacs for SDI.** Jameson, R.A. (Los Alamos National Lab., NM). *Nuclear Instruments and Methods in Physics Research, Section B: Beam Interactions with Materials and Atoms;* **24/25**: No. 2, 725-729(Apr 1987). (CONF-861114—).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Radio-frequency linear accelerators are key elements of Strategic Defense Initiative systems for producing neutral particle beams and for producing photon radiation using free-electron lasers. The R and D work for these applications will result in significant advances in all aspects of accelerators and supporting systems that will also benefit the application of these devices in other areas. Aspects of the current development work are outlined, and prospects for broader application are discussed.

41703 **Accelerator research for heavy ion inertial fusion.** Godlove, T.F. (Dept. of Energy, Washington, DC). *Nuclear Instruments and Methods in Physics Research, Section B: Beam Interactions with Materials and Atoms;* **24/25**: No. 2, 736-740(Apr 1987). (CONF-861114—).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

It is now one decade since serious consideration was first given to the use of heavy ion accelerators for inertial confinement fusion. After an initial period of wide-ranging studies, the US program settled on an induction linac method proposed by Lawrence Berkeley Laboratory (LBL). The ion kinetic energy is modest (30-100 MeV/amu, 5-10 GeV total) but intense beam currents of order 1 kA per beam in 10-30 beams are required on target in a short pulse of order 10-20 ns. In this review the conceptual designs are described, together with recent theory and experiments on high-current beam transport and use of multiple beams. Parallel efforts in West Germany, Japan and the Soviet Union are mentioned, and a two-year US study of heavy ion fusion electric power plants is summarized.

41704 **Proton accelerator for medical applications.** Martin, R.L. (Argonne National Lab., IL). *Nuclear Instruments and Methods in Physics Research, Section B: Beam Interactions with Materials and Atoms;* **24/25**: No. 2, 1087-1091(Apr 1987). (CONF-861114—).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

The conceptual design of a proton synchrotron for radiation treatment of cancer in a hospital is described. The proton energy would be variable on a pulse-pulse basis up to 250 MeV with a maximum accelerated current of 60 nA average at a 5 Hz repetition rate. The ring would consist of a number of small straight magnets for ease of construction and flexibility of arrangement of dipoles, quadrupoles, and drift spaces. The ring would be 23 ft in diameter. The same magnets (2 times the number) could also be arranged in a ring of twice the diameter. The synchrotron would then accelerate helium ions to 250 MeV/μ, suitable for the full range of radiation treatment. A major feature of this larger synchrotron, which is the one described below, is the ability to accelerate negative hydrogen ions to 250 MeV (with lower peak magnetic fields to avoid magnetic stripping of the ions) and utilize charge exchange extraction. The

latter technique appears to be most promising for satisfying the requirements for dynamic raster scanning of narrow proton beams.

41705 **Fermilab site-fillers as CAMEL prototypes.** Ankenbrandt, C.M. (Fermilab National Accelerator Lab., Batavia, IL 60510). pp 336-337 of Proceedings of the 1982 DPF summer study on elementary particle physics and future facilities. Donaldson, R.; Gustafson, R.; Paige, F. Washington, DC; National Science Foundation (1982). (CONF-8206116—).

From DPF summer study on elementary particle physics and future facilities (APS); Aspen, CO, USA (28 Jun 1982).

At Snowmass, beam energies greater than about 10 TeV dominated the intellectual efforts related to hadron-hadron colliders. The anticipated cost and scope of these machines spurred the search for cost-cutting innovations and for a suitable site, perhaps in the southwestern desert. (Given its probable location and method of design, CAMEL seems an appropriate acronym for such a facility.) A prototype of more modest time-scale, cost, and energy is needed to bridge the physics gap until completion of CAMEL and to establish the feasibility of various proposed technologies. Building a prototype at Fermilab would reduce its cost, speed its completion, and improve its performance by taking advantage of existing real estate and expertise and by exploiting fully the potential capabilities of existing facilities (injectors, antiproton accumulator, etc.). The design and expected performance of various Fermilab site-filling (R = 2.4 km) antiproton-proton colliders are discussed. Other options are also described.

41706 **Plans for LAMPF II.** Thiessen, H.A. (Los Alamos National Lab., Los Alamos, NM 87545). pp 556-566 of Proceedings of the 1982 DPF summer study on elementary particle physics and future facilities. Donaldson, R.; Gustafson, R.; Paige, F. Washington, DC; National Science Foundation (1982). (CONF-8206116—).

From DPF summer study on elementary particle physics and future facilities (APS); Aspen, CO, USA (28 Jun 1982).

A high-intensity 16- to 32-GeV proton accelerator is proposed. Several major areas of physics would benefit, including muons, neutrino physics, rare kaon decays, hypernuclei, and antiproton physics. The possibilities for constructing such a machine on the Los Alamos site and a preliminary cost estimate are discussed.

41707 **A 1 TeV on 1 TeV p-barp collider at Fermilab using superferric magnets.** Mantsch, P. (Fermilab National Accelerator Lab., Batavia, IL 60510). pp 343-344 of Proceedings of the 1982 DPF summer study on elementary particle physics and future facilities. Donaldson, R.; Gustafson, R.; Paige, F. Washington, DC; National Science Foundation (1982). (CONF-8206116—).

From DPF summer study on elementary particle physics and future facilities (APS); Aspen, CO, USA (28 Jun 1982).

A dedicated 1 TeV on 1 TeV p-bar p collider at Fermilab would allow both collider and fixed-target experiments to proceed in parallel with a corresponding increase in physics capability. A 2.5 T (nominal) superferric magnet ring of 2 km radium would also allow the development of magnets, enclosure and refrigeration systems for a very large 32 km radius - 20 TeV machine of the future. An attempt is made to estimate the cost of a prototype ring using many of the cost saving ideas put forth by those working on the 20 TeV machine. The magnets are based on Wilson's superferric magnet. The magnet system of the prototype, however, would not have the advantage of the economy of scale afforded by a machine 20 times larger. Cost estimates are given and a hypothetical magnet design and production scenario are assumed along with a Main Ring type lattice. Costs are then based as nearly as possible on the Energy Saver experience. The magnet for Fermilab prototype ring would be as close as possible to that used in the desert machine. The emphasis of the design would then be on low cost, ease of production, and reliability.

4302 Beam Dynamics, Field Calculations, And Ion Optics

REFER ALSO TO CITATION(S) 41627, 41698, 41700, 41737, 41744, 41786, 42350

41708 **(ANL-HEP-CP—87-24) Transverse focussing using plasma wake fields.** Cline, D.B.; Cole, B.; Rosenzweig, J.; Norem, J. (Wisconsin Univ., Madison (USA); California Univ., Los Angeles (USA); Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 4p. (CONF-870302—213). NTIS, PC A02. File Number DE87011503.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Dense particle beams traveling in plasmas can produce very high electric and magnetic fields, and these fields can be used to accelerate and focus particles. The effects on trailing beams and self focusing can be strong and nonlinear. This paper discusses two aspects of self pinching beams: (1) the production of beams which do not self pinch, and (2) a short focal length plasma lens which uses self pinching to reduce beam sizes at the interaction point of a linear collider. As an example, a final focus system for the Stanford Linear Collider is considered. It is shown how the luminosity could be increased using this system.

41709 **(ANL-HEP-CP—87-27) Vacuum chamber for an undulator straight section.** Kim, S.; Wehrle, R.; Genens, L. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 3p. (CONF-870302—217). NTIS, PC A02. File Number DE87011502.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

A prototype aluminum extruded vacuum chamber for an undulator straight section of the Advanced Photon Source is described. The 52.-m long vacuum system is designed so that the undulator gap variation does not interfere with it. The chamber is gripped in a stiff close toleranced mounting structure to insure dimensional tolerance of the chamber height.

41710 **(EFI—861(12)-86) Radiation field of a charged particle in the waveguide at its arbitrary motion.** Barsukov, K.A.; Ryazantseva, N.V.; Begloyan, Eh.A.; Laziev, Eh.M. (Erevanskij Fizicheskij Inst. (USSR)). 1986. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702704.

The method of finding the radiation fields and energy of charged particles moving in waveguides by the arbitrary law is presented. Expressions are obtained similar to the spectral expansions of Lienar-Wichert potentials for free space. 3 references, 1 figure.

41711 (JINR—D-10-11-84-818, pp 151-153) **Analysis of the methods for general correction of an equilibrium orbit in a synchrotron.** Zhidkov, E.P.; Mikhajlov, V.A.; Fedorov, A.V. 1985. (In Russian). NTIS (US Sales Only), PC A16/MF A01. File Number DE87780164. (CONF-8309402—).

From 5. international meeting on problems of mathematical simulation, programming, and mathematical methods for solving the physical problems; Dubna, USSR (20 Sep 1983).

The methods for calculating magnetic fields necessary for correcting variations in particle equilibrium orbit from the ideal one in a heavy ion synchrotron are considered. The differential equation used in experiments on compreterized simulation of a maximum distortion of the equilibrium orbit with regard to the tolerances for the magnetic field disturbances and magnet alignment is given. 5 refs.

41712 (JINR—D-10-11-84-818, pp 154-156) **On an algorithm for accounting the field nonlinearities in the problem of charged particle beam transport.** Zhidkov, E.P.; Kircheva, V.; Polyakova, R.V.; Shelaev, I.A.; Yudin, I.P. 1985. (In Russian). NTIS (US Sales Only), PC A16/MF A01. File Number DE87780164. (CONF-8309402—).

From 5. international meeting on problems of mathematical simulation, programming, and mathematical methods for solving the physical problems; Dubna, USSR (20 Sep 1983).

A solution of problem on simulating charge particle multiturn motion in a magnetic field is considered. A new approach to taking account of the field nonlinearities is proposed. The advanced algorithm is used for computerized simulation of charged particle beam transport in the 1.5 GeV superconducting proton synchrotron prototype. 2 refs.; 1 fig.

41713 (JINR—D-10-11-84-818, pp 181-183) **Calculating the dispersion characteristics of periodical accelerating structures.** Kaschiev, M.S.; Kaschieva, V.A.; Puzynin, I.V.; Gonin, I.V.; Paramonov, V.V. (Joint Inst. for Nuclear Research, Dubna, USSR; AN SSSR, Moscow. Inst. Yadernykh Issledovanij). 1985. (In Russian). NTIS (US Sales Only), PC A16/MF A01. File Number DE87780164. (CONF-8309402—).

From 5. international meeting on problems of mathematical simulation, programming, and mathematical methods for solving the physical problems; Dubna, USSR (20 Sep 1983).

The problem of calculating the dispersion characteristics for the periodical structure with an arbitrary number of periods is formulated. A method for its numerical solution is proposed. The dependence of oscillation frequency on the oscillation mode is meant as the system dispersion characteristic. Only homogeneous azimuthal oscillations are considered. It is assumed that the stucture period is symmetrical. The problem numerical solution is found by the finite element method using isoparametical eight-node elements in a quadrangle. The calculation results for an accelerating structure with conducting disks and washers consisting of 6 sections are given as an example. 11 refs.

41714 (JINR—D-10-11-84-818, pp 198-200) **Adams type multistep methods based on algebraic, trigonometric and exponential interpolations.** Zhidkov, E.P.; Semerdzhiev, Kh.I. 1985. (In Russian). NTIS (US Sales Only), PC A16/MF A01. File Number DE87780164. (CONF-8309402—).

From 5. international meeting on problems of mathematical simulation, programming, and mathematical methods for solving the physical problems; Dubna, USSR (20 Sep 1983).

Different versions of the Adams method used for solving the Cauchy problem are considered. The algorithm applied for numerical studies of betatron oscillations of relativistic electrons forming a toroidal beam is described. 7 refs.

41715 (JINR—D-10-11-84-818, pp 204-206) **Program for simulating ion storage in electron beams.** Perel'shtejn, Eh.A.; Shevtsov, V.F.; Shirkov, G.D.; Shchinov, B.G. 1985. (In Russian). NTIS (US Sales Only), PC A16/MF A01. File Number DE87780164. (CONF-8309402—).

From 5. international meeting on problems of mathematical simulation, programming, and mathematical methods for solving the physical problems; Dubna, USSR (20 Sep 1983).

The ion program meant for simulating processes in electron-ion beams using the large-sized particle method is described. The program permits to study electron-ion and ion-ion processes, as well as dynamics of the distribution functions considering at the same time up to 10,000 particles representing the electron and several ion components. The calculation results for accumulation of ions with four different charges in an electron beam and the data characterizing variations of root-mean-square dimensions of the electron and ion components depending on the beam neutralization factor are given. 9 refs.; 4 figs.

41716 (JINR—D-10-11-84-818, pp 219-221) **On the existence of the solution for self-congruent electrodynamical problem.** Kadantseva, E.P. 1985. (In Russian). NTIS (US Sales Only), PC A16/MF A01. File Number DE87780164. (CONF-8309402—).

From 5. international meeting on problems of mathematical simulation, programming, and mathematical methods for solving the physical problems; Dubna, USSR (20 Sep 1983).

The algorithm for solving a boundary-value self-congruent problem appeared when calculating electromagnetic fields excited in a cavity resonator by dense electron beam motion is considered. Using the finite difference method the existence of a generalized solution of the problem under consideration is demonstrated. 4 refs.

41717 (JINR—D-10-11-84-818, pp 264-266) **Mathematical simulation of charged particle beam aberration distortions.** Nagaenko, M.G.; Severgin, Yu.P. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad, USSR). 1985. (In Russian). NTIS (US Sales Only), PC A16/MF A01. File Number DE87780164. (CONF-8309402—).

From 5. international meeting on problems of mathematical simulation, programming, and mathematical methods for solving the physical problems; Dubna, USSR (20 Sep 1983).

The problem of minimizing nonlinear distortions of charged particle beam emittance in systems for beam transport and shaping is considered. The equation of a surface bounding the four-dimensional volume occupied by the beam particles at the inlet into the magneto-optical system under investigation and the system of equations determining the conditions of optimum compensation of nonlinear distortions by the radial beam envelope are given. It is shown that the systems of equations for calculating the distorted phase volume characteristics are reduced to the systems of nonlinear algebraic equations with well-developed methods of solution. 5 refs.

41718 **(LA—11054-MS) TRACE 3-D documentation.** Crandall, K.R. (Los Alamos National Lab., NM (USA)). Aug 1987. Contract W-7405-ENG-36. 89p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87012107.

TRACE 3-D is an interactive beam-dynamics program that calculates the envelopes of a bunched beam, including linear space-charge forces, through a user-defined transport system. TRACE 3-D provides an immediate graphics display of the envelopes and the phase-space ellipses and allows nine types of beam-matching options. This report describes the beam-dynamics calculations and gives detailed instruction for using the code. Several examples are described in detail.

41719 **(SAND—87-0110C) Pulsed power requirements for the Sandia recirculating electron beam linac.** Tucker, W.K.; Shope, S.L.; Hasti, D.E. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC02-76CH00016. 5p. (CONF-870656—10). NTIS, PC A02/MF A01; GPO Dep. File Number DE87011314.

From 6. Institute of Electrical and Electronic Engineers pulsed power conference; Arlington, VA, USA (29 Jun 1987).

Compact, high gradient, linear induction accelerators may be achieved by recirculating the electron beam in phase with a repeating accelerating voltage. A two-cavity recirculating accelerator has been designed and operated in a single-pass mode. The prototype accelerator uses a 2.5-MV, 20-kA, 25-ns duration injector and an accelerating cavity that will produce a total accelerating voltage of 5.3 MV for four passes. The design of this machine involved key areas of development in pulsed power, specifically, low-jitter spark gaps and vacuum-liquid interfaces for bipolar electric fields. The extension of this technology to multiple-pulse machines will require advances in liquid dielectric breakdown strength and switch surface flashover, as well as additional improvements in lower inductance switching and vacuum-liquid interface flashover. This paper will discuss the recirculation concept, pulsed-power design parameters, machine scaling relationships that are valid for state-of-the-art and near-term pulsed-power parameters, and summarize the pulsed-power and beam transport experiments.

41720 **(SLAC-PUB—4093) Calculations and measurements for the SLAC SLC positron return quadrupole magnet.** Early, R.A.; Cobb, J.K. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Sep 1986. Contract AC03-76SF00515. 3p. (CONF-870302—191). NTIS, PC A02. File Number DE87010322.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The three-dimensional magnetostatic computer program TOSCA, running on the NMFECC CRAY X-MP computer, was used to compute the integral of gradient length for the SLC type QT4 positron return line quadrupole magnet. Since the bore diameter of the magnet is 12.7 centimeters, and the length is only 10.16 centimeters, three dimensional effects are important. POISSON calculations were done on a two-dimensional model to obtain magnetic shimming which assured enough positive twelve pole to offset

end effects, while TOSCA was used to estimate the effective length of the quadrupole. No corrections were required on the magnet as built. Measurements showed that the required integrated gradient was achieved for the given current, and that integrated higher harmonics were generally less than 0.1% of the quadrupole component.

41721 **(SLAC-PUB—4103) Single particle dynamics in circular accelerators.** Ruth, R.D. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Oct 1986. Contract AC03-76SF00515. 44p. (CONF-850771—12). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87008318.

From SLAC summer school on the physics of high energy particle accelerators; Stanford, CA, USA (15 Jul 1985).

The purpose of this paper is to introduce the reader to the theory associated with the transverse dynamics of single particle, in circular accelerators. The discussion begins with a review of Hamiltonian dynamics and canonical transformations. The case of a single particle in a circular accelerator is considered with a discussion of non-linear terms and chromaticity. The canonical perturbation theory is presented and nonlinear resonances are considered. Finally, the concept of renormalization and residue criterion are examined. (FI)

41722 **(SLAC-PUB—4169) Wakefield effects in a linear collider.** Bane, K.L.F. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Dec 1986. Contract AC03-76SF00515. 23p. (CONF-840873—7). NTIS, PC A02. File Number DE87005577.

From US summer school on high energy particle accelerators; Batavia, IL, USA (13 Aug 1984).

In this paper the wakefields for the Stanford Linear Accelerator Center (SLAC) accelerating structure are first discussed, and then some considerations dealing with the longitudinal wakefields are described. The main focus is on the effects of the transverse wakefield on the beam, including the case when there is an energy variation along the bunch. The use of an energy spread to inhibit emittance growth in a linac, indeed to damp the oscillations of the core of the bunch to below the unperturbed betatron oscillations, (in a process that is similar to Landau Damping) is qualitatively detailed. The example of the SLC, including errors, is also in detail.

41723 **(SLAC-PUB—4181) Experimental beam dynamics in the SLC [SLAC Linear Collier] linac.** Steeman, J.T.; Campisi, I.E.; Herrmannsfeldt, W.; Lee, M. (Stanford Linear Accelerator Center, Menlo Park, CA (USA); Lawrence Berkeley Lab., CA (USA); California Univ., Santa Cruz (USA); California Inst. of Tech., Pasadena (USA)). Jan 1987. Contract AC03-76SF00515. 5p. (CONF-870302—206). NTIS, PC A02. File Number DE87011587.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The component installation for the upgrade of the three-kilometer linac for the SLAC Linear Collider (SLC) was completed in late summer 1986. The system status and measurements of beam properties made during commissioning are described in this paper. In summary, a low-emittance electron beam from a damping ring has been accelerated through the linac and injected into the north SLC Arc with negligible loss. The maximum bunch intensity is 2.9 x 10^{10} electrons/pulse. A peak particle energy of 53 GeV has been reached. Operation at 47 GeV is now routine. The energy and energy spectrum of the electron beam can be rapidly measured nondestructively at high energy. These signals will be used in a fast feedback system nearing completion. The electron beam can be centered in the accelerator to about 200 μm rms. Slow feedback of the injection position and angle into the linac and injection into the north Arc are operational. Longitudinal and transverse wakefields have been measured and appear to be near expectations. Transverse position measurements at the end of the linac show a 120 μm horizontal and a 30 μm vertical (rms) jitter from pulse to pulse. The spot shape, including the transverse tails, also shows some jitter. The transverse position and shape fluctuations have several sources involving launch instabilities, chromatic effects, RF deflections and lattice mismatches. Continued improvements are expected. These parameter jitters would not preclude collisions. The measured invariant transverse emittances of the beam at 47 GeV are 2 x 10^{-5} rm vertically and 12-25 x 10^{-5} rm horizontally at 1 x 10^{10} e^{-}. The horizontal emittance increases with beam intensity. Damped positrons have been injected into the linac, and trajectory correction is underway.

41724 **(SLAC-PUB—4182) Transverse wakefield control and feedback in the SLC [SLAC Linear Collider] linear.** Seeman, J.T.; Campisi, I.E.; Herrmannsfeldt, W.; Lee, M.; Petersen, A.; Phinney, N.; Ross, M.; Abrams, G.S.; Adolphsen, C.; Soderstrom, E. . (Stanford Linear Accelerator Center, Menlo Park, CA (USA); Lawrence Berkeley Lab., CA (USA); California Univ., Santa Cruz (USA); California Inst. of Tech., Pasadena (USA)). Jan 1987. Contract AC03-76SF00515. 9p. (CONF-870302—207). NTIS, PC A02. File Number DE87011588.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Transverse wakefields in the linac of the SLAC Linear Collider (SLC) have been observed to enlarge the effective emittance of beams which are not properly centered in the accelerating structure. A fast feedback system has been constructed to minimize the enlargement under changing conditions by controlling the beam launching parameters. Theoretical aspects of this transverse feedback system are reviewed as well as the design of the beam sensors, launch controllers, communication equipment and data processing micro-computer. A variety of beam observations have been made. They show that dispersion as well as wakefield effects are important. In the near future the fast transverse feedback system will be beam tested, and algorithms tailored to the noise environment of the SLC will be tried.

41725 **(ZfK—593) Ion optical investigations at the Rossendorf EGP-10-1 tandem accelerator.** Friedrich, M. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). Aug 1986. 40p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE87702873.

A review of the ion optical investigations at the Rossendorf EGP-10-1 tandem accelerator is given. Based on ion optical calculations the availability of the accelerator has been increased and the possibilities of its application in nuclear physical experiments have been extended. The improvement of beam parameters is demonstrated by selected examples.

41726 **Nonlinear saturation of the longitudinal modes of the coasting beam in a storage-ring.** Bogacz, S.A.; Ng, K. (Accelerator Theory Department, Fermi National Accelerator Laboratory, P.O. Box 500, Batavia, Illinois 60510). *Physical Review [Section] D: Particles and Fields;* **36**: No. 5, 1538-1542(1 Sep 1987).

A simple nonlinear model of a coasting beam coupled to a sharp storage-ring impedance is formulated in the framework of the quasilinear Vlasov equation. Nonperturbative analytic treatment of the Vlasov equation allows us to study time evolution of a single coherent mode (an azimuthal harmonic of the density driven by the impedance) and the overall uniform-density distribution function. In the case of a Gaussian beam, this formalism simplifies to a pair of equations of motion which together with the dispersion relation fully describe the dynamics of the beam. Further numerical treatment reveals saturation of the mode growth which simultaneously provides a stabilizing mechanism (via Landau damping) for the overall distribution function. Some predictions about the energy overshoot and coherent-instability lifetime are made on the basis of the presented formalism.

41727 **Beam strahlung effects in e-p collider.** Cho, Y. (Argonne National Lab., Argonne, IL 60439). pp 305-306 of Proceedings of the 1982 DPF summer study on elementary particle physics and future facilities. Donaldson, R.; Gustafson, R.; Paige, F. Washington, DC; National Science Foundation (1982). (CONF-8206116—).

From DPF summer study on elementary particle physics and future facilities (APS); Aspen, CO, USA (28 Jun 1982).

The electromagnetic fields produced by one beam in an interaction point of a colliding beam facility cause to the emission of synchrotron radiation by the other beam. This effect, the beam

strahlung, for the e/sup +/e/sup -/ colliders has been considered previously and it has been pointed out that the effect is very important consideration at very high energy e/sup +/e/sup -/ colliders. At the first glance, the beam strahlung effect can play an important role in the e-p collision due to the fact that the circulating currents in the collider are much higher than those of the e/sup +/e/sup -/ machine. However the detailed study shows that is not the case because of the collision geometry involved. What follows in this paper is the beam strahlung derivations using the method previously used. The difference between this note and that of the previous study is that in the case of e/sup +/e/sup -/ collider, equal mass particles are involved in the consideration and, in the e-p case, the electrons radiates and the protons provide the electromagnetic fields.

41728 **Emittance reduction by H/sup -/ charge exchange for Hadron-Hadron colliding beams.** Ankenbrandt, C.M. (Fermi National Accelerator Lab., Batavia, IL 60510). pp 341-342 of Proceedings of the 1982 DPF summer study on elementary particle physics and future facilities. Donaldson, R.; Gustafson, R.; Paige, F. Washington, DC; National Science Foundation (1982). (CONF-8206116—).

From DPF summer study on elementary particle physics and future facilities (APS); Aspen, CO, USA (28 Jun 1982).

Novel applications of charge-exchange injection of negative hydrogen ions are proposed in order to reduce proton beam transverse and longitudinal emittances to the values desired for a very high energy hadron-hadron colliding beam facility. For the beams which will be used in the collider, reducing the transverse emittances is most important; for the proton beam used to produce antiprotons, reducing the longitudinal emittance is paramount.

41729 **Fixed target accelerator subgroup.** Fisk, E.; Mac Lachlan, J.A. (Fermi National Accelerator Lab., Batavia, IL 60510). pp 347-350 of Proceedings of the 1982 DPF summer study on elementary particle physics and future facilities. Donaldson, R.; Gustafson, R.; Paige, F. Washington, DC; National Science Foundation (1982). (CONF-8206116—).

From DPF summer study on elementary particle physics and future facilities (APS); Aspen, CO, USA (28 Jun 1982).

The authors consider what is additionally needed to render a facility optimized for very high energy pp or pp-bar p collisions suitable for a robust fixed target program and what are the features and cost of a very high intensity proton accelerator at medium energy. For the first topic the focus has been on the longer range future exemplified by a 20 TeV ring or rings. The second topic is the option of creating within the next ten years a facility serving the needs of both particle physics (e.g. rare K decays, hyperon beams, intense neutrino beams) and nuclear physics (e.g. hypernuclei, K scattering) and providing as well intense muon beams of interest to both particle and solid state physicists. The two topics reflect a division of interest in the fixed target subgroup, and there was limited joint effort between those concerned with the two topics except relevant to their mutual concerns with targetry and managing beam loss. Thus, this paper is also disjoint. Those considering very high energy treat mostly in a qualitative fashion the differences between a hadron storage ring and an accelerator for making external beams; those considering very high intensity medium energy accelerators have been more concrete and considered a complete facility modeled on the LAMPF II proposal.

41730 **Formulas and scaling laws for thresholds of coherent instabilities of storage ring beams.** Teng, L.C. (Fermi National Accelerator Lab., Batavia, IL 60510). pp 353-356 of Proceedings of the 1982 DPF summer study on elementary particle physics and future facilities. Donaldson, R.; Gustafson, R.; Paige, F. Washington, DC; National Science Foundation (1982). (CONF-8206116—).

From DPF summer study on elementary particle physics and future facilities (APS); Aspen, CO, USA (28 Jun 1982).

The traditional forms of the formulas giving the longitudinal (subscript iota) and the transverse (subscript t) instabilities of a charged particle beam travelling inside the vacuum pipe of a storage ring are presented. The formula is derived for a continuous (coasting) beam but can also be applied to a bunched beam.

4303 Auxiliaries And Components

REFER ALSO TO CITATION(S) 41719, 41729, 41784, 41830, 42796

41731 **(ANL-HEP-CP—87-20) Shielding design for the proposed Advanced Photon Source at Argonne.** Moe, H.J.; Veluri, V.R. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 4p. (CONF-870302—219). NTIS, PC A02. File Number DE87011495.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Bulk shielding was designed for the proposed Argonne Advanced Photon Source. The shielding is for two linacs, the positron converter, booster synchrotron, and the storage ring. Shielding design limits exposure to 20 mrem/wk for occupational and 25 mrem/y for an individual member of the public from the radiation products, which include high energy neutrons (HEN), giant resonance neutrons (GRN), and Bremsstrahlung radiation (BR). The beam loss parameters at various components were estimated. Dose rates were computed for continuous loss during beam decay using an empirical method. Normal operational losses and certain accidental beam losses were also considered.

41732 **(ANL-HEP-CP—87-22) Vacuum chamber development for the synchrotron x-ray source at Argonne.** Nielsen, R.; Moenich, J.; Wehrle, R. (Argonne National Lab., IL (USA)). Mar 1987. Contract W-31109-ENG-38. 3p. (CONF-870302—218). NTIS, PC A02. File Number DE87011494.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

A vacuum test chamber 1.6 meters in length for the synchrotron x-ray source has been completed and tested for the evaluation of welding, sealing and ultra high vacuum (UHV) applications. A base pressure of 6.5 x 10^{-11} Torr (nitrogen equivalent) has been achieved. The pumping system consists of non-evaporable getter (NeG) strips. The pumpdown procedure, NeG characteristics and results are discussed.

41733 **(BNL—39648) Correlator filters for feedback at SRS and NSLS.** Dykes, D.M.; Galayda, J.N. (Brookhaven National Lab., Upton, NY (USA); Daresbury Lab. (UK)). 1987. Contract AC02-76CH00016. 4p. (CONF-870302—194). NTIS, PC A02. File Number DE87010067.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

In order to amplify signals that are produced by an oscillating beam, it is desirable to first reject that part of the signal produced when the beam is not oscillating. This can be done through the use of correlator filters which have the advantages of simplicity, at least 200 MHz working bandwidth, and broadband matching to 50 ohms at both input and output. Correlator filters have been built for the National Synchrotron Light Source (NSLS), the Daresbury SRS storage ring, and the NSLS x-ray ring. This report describes the performance of the filters and their associated electronic circuits. (FI)

41734 **(BNL—39673) High precision power supplies for the National Synchrotron Light Source.** Olsen, R.; Langenbach, H. (Brookhaven National Lab., Upton, NY (USA)). Apr 1987. Contract AC02-76CH00016. 4p. (CONF-870302—189). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010455.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Since beam stability depends to a considerable degree on the stability of the magnet power supplies, and it is desired to push for 3 GeV operation, it was required that new power supplies be obtained for the quadrupoles and sextupoles. These power supplies were to have the lowest ripple that could be reasonably achieved, and were to have a current regulation of better than 10 PPM. In addition, since they operate over a 5 : 1 voltage range, it was considered desirable to ensure that they operated with a good power factor over the operating range. The dipole power supply was modified to use the techniques employed in the smaller supplies.

41735 **(BNL—39684) Superconducting magnets.** Willen, E.; Dahl, P.; Herrera, J. (Brookhaven National Lab., Upton, NY (USA)). 1985. Contract AC02-76CH00016. 50p. (CONF-850771—11). NTIS, PC A03. File Number DE87010046.

From SLAC summer school on the physics of high energy particle accelerators; Stanford, CA, USA (15 Jul 1985).

This report provides a self-consistent description of a magnetic field in the aperture of a superconducting magnet and details how this field can be calculated in a magnet with cos θ current distribution in the coils. A description of an apparatus that can be used to measure the field uniformity in the aperture has been given. Finally, a detailed description of the magnet being developed for use in the Superconducting Super Collider is given. When this machine is built, it will be by far the largest application of superconductivity to date and promises to make possible the experimental discoveries needed to understand the basic laws of nature governing the world in which we live.

41736 **(BNL—39890) Analysis of surface contaminants on beryllium and aluminum windows.** Gmur, N.F. (Brookhaven National Lab., Upton, NY (USA)). Jun 1987. Contract AC02-76CH00016. 37p. (CONF-870610—2). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011299.

From 5. national synchrotron radiation instrumentation conference; Madison, WI, USA (21 Jun 1987).

An effort has been made to document the types of contamination which form on beryllium window surfaces due to interaction with a synchrotron radiation beam. Beryllium windows contaminated in a variety of ways (exposure to water and air) exhibited surface powders, gels, crystals and liquid droplets. These contaminants were analyzed by electron diffraction, electron energy loss spectroscopy, energy dispersive x-ray spectroscopy and wet chemical methods. Materials found on window surfaces include beryllium oxide, amorphous carbon, cuprous oxide, metallic copper and nitric acid. Aluminum window surface contaminants were also examined.

41737 **(CONF-870302—210) Spectral character of optimized undulator insertion devices for the Synchrotron X-ray Source at Argonne.** Kim, S.H.; Viccaro, P.J.; Shenoy, G.K. (Argonne National Lab., IL (USA)). Mar 1987. Contract W-31109-ENG-38. 4p. NTIS, PC A02. File Number DE87011499.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Two general types of undulator x-ray sources are planned for the Advanced Photon Source (APS) to be built at Argonne. One is to provide first harmonic radiation tunable over the interval of 7 to 14 keV during the initial phase of operation of the storage ring. This tunability range will increase for the same device to approximately 4.7 to 14 keV during the mature phase of operation. A second device with a smaller period is planned for those cases where the intensity of the third harmonic radiation from the above device is not sufficient. In this case, the undulator will provide 20 keV radiation in the first harmonic. The magnetic design of both devices will be a hybrid type which uses the Nd-Fe-B alloy as the permanent magnet material and vanadium permendur as the pole-tip. As part of the optimization scheme, the magnetic field calculations have been carried out using a version of the two dimensional field code PANDIRA. In this approximation, the width of the undulator is assumed to be infinite. Three dimensional effects associated to finite pole widths have been estimated using experimental results of single pole measurements for a 7 cm period device. In addition, numerical calculations of the spectral characteristics have been done using the magnetic design parameters and taking into account the emittance expected for the APS. On-axis brilliance results as well as expected spectral power densities have been determined.

41738 **(CONF-8609234—8) Analysis of the burping behavior of the cold solid methane moderator at IPNS [Intense Pulsed Neutron Source].** Carpenter, J.M.; Walter, U. (Argonne National Lab., IL (USA); Missouri Univ., Columbia (USA)). 1986. Contract W-31109-ENG-38. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011351.

From International collaboration on advanced neutron sources; Villigen, Switzerland (22 Sep 1986).

Examination of the cold solid methane moderator at IPNS (Model II) revealed that a circumferential weld failed due to high internal pressure, such as would be caused by thermal expansion of solid methane or the release of Hydrogen gas upon spontaneous heating. This weld is the main object of current attention for a design of a replacement. The present paper deals with the processes which lead to the burping behavior and outlines the analysis of some of the consequences. The purpose is to determine conditions under which the system can operate at the lowest possible temperature, avoiding the problems experienced to data.

41739 **(CONF-8609234—9) Deterioration of performance of neutron moderators under intense irradiation.** Carpenter, J.M.; Cudrnak, S.S.; DeCusatis, C.M. (Argonne National Lab., IL (USA)). 1986. Contract W-31109-ENG-38. 34p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011350.

From International collaboration on advanced neutron sources; Villigen, Switzerland (22 Sep 1986).

In pulsed neutron sources, fixed moderators such as polyethylene and solid methane slow down fast (MeV) neutrons from the primary source to energies of use for spectroscopy ($\leqq$10 eV). Radiation-induced changes in their composition alter their spectral and pulse characteristics. We report the results of fitting time-average spectra from polyethylene and solid methane moderators in Argonne's Intense Pulsed Neutron Source as a function of total fast-neutron radiation dose. The thermal-to-epithermal flux ratio varies most significantly, while the Maxwellian energy and the parameters describing the epithermal component change only slightly. We have used modified forms of Westcott's joining function for this purpose. We provide an integral of the spectrum that is useful for determining the delayed neutron background.

41740 **(DOE/ER/40150—20) CEBAF [Continuous Electron Beam Accelerator Facility] superconducting cavity rf drive system.** Fugitt, J.A.; Moore, T.L. (Continuous Electron Beam Accelerator Facility, Newport News, VA (USA)). 1987. Contract AC05-84ER40150. 5p. (CEBAF-PR—87-005; CONF-870302—201). NTIS, PC A02. File Number DE87008663.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The CEBAF rf system consists of 418 individual rf amplifier chains. Each superconducting cavity is phase locked to the master drive reference line to within 1 degree, and the cavity field gradient is regulated to within 1 part in 10^4 by a state-of-the-art rf control module. Precision, continuously adjustable, modulo 360^0 phase shifters are used to generate the individual phase references, and a compensated rf detector is used for level feedback. The close coupled digital system enhances system accuracy, provides self-calibration, and continuously checks the system for malfunction. Calibration curves, the operating program, and system history are stored in an on board EEPROM. The rf power is generated by a 5kW, water cooled, permanent magnet focused klystron. The klystrons are clustered in groups of 8 and powered from a common supply. rf power is transmitted to the accelerator sections by semiflexible waveguide.

41741 **(EFI—823(50)-85) Possibility of producing ^{123}I for radioisotope diagnostics at EFI electron linac.** Agababyan, K.Sh.; Demekhina, N.A. (Erevanskij Fizicheskij Inst. (USSR)). 1985. 20p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702675.

The results of investigating the possibility of radioactive iodine isotope (^{123}I) production of the EFI electron linac are reported. The advantages of electron accelerator application for ^{123}I production are shown. The product obtained has high radionuclide purity that sufficiently simplifies the procedure of radiochemical purification and separation. Absense of impurities decreases total activity of a target after irradiation that simplifies the problems of biological shielding. Electron accelerators are cheaper than cyclotrons. 12 references, 6 figures, 3 tables.

41742 **(FNAL/C—87/62) CDF [Collider Detector at Fermilab] calorimetry.** Jensen, H.B. (Fermi National Accelerator Lab., Batavia, IL (USA)). Mar 1987. Contract AC02-76CH03000. 12p. (CONF-8703128—2). NTIS, PC A02. File Number DE87009436.

From International conference on advances in experimental methods for colliding beam physics; Stanford, CA, USA (9 Mar 1987).

The Collider Detector at Fermilab (CDF) is a large detector built to study 2 TeV anti p p collisions at the Fermilab Tevatron. The calorimetry, which has polar angle coverage from 2° to 178°, and complete azimuthal coverage within this region, forms the subject of this paper. It consists of both electromagnetic shower counters (EM calorimeters) and hadron calorimeters, and is segmented into about 5000 "towers" or solid angle elements.

41743 **(FNAL-TM—1452) A one-campus SSC.** Lederman, L.M.; Teng, L.C. (Fermi National Accelerator Lab., Batavia, IL (USA)). Apr 1987. Contract AC02-76CH03000. 12p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87010298.

Advantages of the one-campus superconducting super collider with bypass-clustered Interaction Region arrangement are enumerated. Designs for double-bypass arrangements with 4 and 6 interaction points are examined and presented. Compared to the conceptual design given in the Conceptual Design Report, the only drawback identified is the additional dipoles required which amounts to ~20% for the 6 Interaction Point arrangements and ~10% for the 4 Interaction Point arrangements. (LSP)

41744 **(FNAL-TM—1456) An improved 8 GeV beam transport system for the Fermi National Accelerator Laboratory.** Syphers, M.J. (Fermi National Accelerator Lab., Batavia, IL (USA)). Jun 1987. Contract AC02-76CH03000. 182p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE87011909.

A new 8 GeV beam transport system between the Booster and Main Ring synchrotrons at the Fermi National Accelerator Laboratory is presented. The system was developed in an effort to improve the transverse phase space area occupied by the proton beam upon injection into the Main Ring accelerator. Problems with the original system are described and general methods of beamline design are formulated. Errors in the transverse properties of a beamline at the injection point of the second synchrotron and their effects on the region in transverse phase space occupied by a beam of particles are discussed. Results from the commissioning phase of the project are presented as well as measurements of the degree of phase space dilution generated by the transfer of 8 GeV protons from the Booster synchrotron to the Main Ring synchrotron.

41745 **(IFVE-OP—86-147) Peculiarities of formation of polarized proton beams from Λ->p,π decay.** Garkusha, V.I.; Kartashev, V.P.; Kotov, V.I.; Novoskol'tsev, F.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 13p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702747.

The paper considers beam production features of the polarized protons from the Λ -> p, π decay. The optical channel scheme meeting the basic requirements of the experiment has been constructed. The channel characteristics for the TeV energy region is presented as an example. 10 references, 5 figures, 1 table.

41746 **(JAERI-M—86-154) Characteristics of gas stripper cell for production of multi-charged ions.** Sataka, M.; Kawatsura, K. (Japan Atomic Energy Research Inst., Tokyo). Oct 1986. 28p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87702634.

A gas stripper cell has been constructed in order to investigate collision processes of multi-charged ions incident on atoms and molecules in a few MeV energy region. This apparatus consists of two parts, namely the gas cell and the charge selector. The design principles as well as the characteristics of the constituent components are described. Experimental results show that this apparatus works well as expected.

41747 **(JINR—9-86-389) Protection of the accelerator RF system against high-voltage break-downs.** Glazov, A.A.; Kalmykov, A.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1986. 4p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702816.

Protection of the accelerator RF system against break-downs is described. The protection operates in two modes: 1) locking the modulator till the end of the accelerating cycle immediately after the first break-down in the RF system to prevent avalanche break-downs (technological protection); 2) switching off the anode power supply of the modulator after a series of consequent break-downs in a number of acceleration cycles (emergency protection). 2 references, 3 figures.

41748 **(JINR—13-86-513) Remote system for measuring the parameters of an ion source.** Romanov, Yu.I.; Turzo, I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1986. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702818.

A multichannel remote system for measuring the parameters of an ion source mounted on a high-voltage terminal is described. The electronic apparatus is made in the CAMAC standart. A 50 m fiber-optical line with a highly energetic source is used for information transmission. Data are transmitted by means of frequency modulation which improves the noise protection of the system. A consecutive order of fifteen sensors makes it possible to perform measurements with a precision of 0.1%. Information is presented to a VT-340 display. 16 references, 7 figures.

41749 **(JINR—13-86-533) Peripheral system for remote control of SPIN setup injector by means of fiber-optical lines.** Romanov, Yu.I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1986. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702819.

The apparatus for remote of an injector of the SPIN setup by means of fiber-optical lines (FOL) is described. The system comprises a multichannel program-controlled timer and devices of two-way communication, TV- and digital telemetry and electric drive control. The electric drive control device provides operation modes of the magnetic elements of a charged particle source. Block-diagrams and electric circuits of some units are given. 11 references, 7 figures.

41750 **(JINR—16-86-486) Comparison of calculated and experimental data on secondary field characteristics near thick targets irradiated by light relativistic nuclei.** Bamblevskij, V.P.; Krylov, A.P.; Timoshenko, G.N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1986. 4p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702822.

The results of comparison of experimental data and values calculated with the aid 10NCAS program data on secondary hadronic field integral and differential characteristics near thick copper and lead targets are described. The target were irradiated by protons and ^{12}C ions with 3.65 GeV/nucleon energy. The good agreement between experiments and calculations allowed one to use the 10NCAS program as initial data for calculations of radiation environment behind the relativistic light ion accelerator shieldings. 7 references, 4 figures.

41751 (JINR—D-10-11-84-818, pp 210-212) **Program for calculating multi-component high-intense ion beam transport.** Kazarinov, N.Yu.; Prejzendorf, V.A. 1985. (In Russian). NTIS (US Sales Only), PC A16/MF A01. File Number DE87780164. (CONF-8309402—).

From 5. international meeting on problems of mathematical simulation, programming, and mathematical methods for solving the physical problems; Dubna, USSR (20 Sep 1983).

The CANAL program for calculating transport of high-intense beams containing ions with different charges in a channel consisting of dipole magnets and quadrupole lenses is described. The equations determined by the method of distribution function momenta and describing coordinate variations of the local mass

centres and r.m.s. transverse sizes of beams with different charges form the basis of the calculation. The program is adapted for the CDC-6500 and SM-4 computers. The program functioning is organized in the interactive mode permitting to vary the parameters of any channel element and quickly choose the optimum version in the course of calculation. The calculation time for the CDC-6500 computer for the 30-40 m channel at the integration step of 1 cm is about 1 min. The program is used for calculating the channel for the uranium ion beam injection from the collective accelerator into the heavy-ion synchrotron. 7 refs.

41752 (JINR—D-10-11-84-818, pp 250-254) **New methods in solving mathematical problem of charges particle analysis and transport.** Tarantin, N.I. 1985. (In Russian). NTIS (US Sales Only), PC A16/MF A01. File Number DE87780164. (CONF-8309402—).

From 5. international meeting on problems of mathematical simulation, programming, and mathematical methods for solving the physical problems; Dubna, USSR (20 Sep 1983).

New methods for deriving analytical expressions describing charged particle trajectories in accelerators are considered. The first and second approximations are used for describing particle beam transformations by magnetic dipoles and quadrupoles. To determine an expression characterizing the relation between the final and initial particle locations conjugation of the initial and final parts of the trajectory expressed in terms of the initial and final particle coordinates, respectively, is used. Conjugation considerably reduces the procedure of analytical consideration and the number of terms in the final formulae for transformation factor. 7 refs.

41753 (JINR—D-10-11-84-818, pp 207-209) **Progpam for calculating high-current magnet systems of a collective accelerator with high-degree field homogeneity.** Aleksandrov, V.S.; Shchinov, B.G. 1985. (In Russian). NTIS (US Sales Only), PC A16/MF A01. File Number DE87780164. (CONF-8309402—).

From 5. international meeting on problems of mathematical simulation, programming, and mathematical methods for solving the physical problems; Dubna, USSR (20 Sep 1983).

The WIST subroutine meant for calculating solenoids with an alternating winding pitch used in collective ion accelerators for shaping magnetic fields of special configurations including highly homogeneous fields with small relative gradient of the longitudinal component is described. The subroutine is used for calculating preaccelerating solenoids, geometry of coils for the transport chamber of the KUTI-20 accelerator induction section, as well as for determining current densities induced in the structural elements of the KUTI prototype. 8 refs.

41754 (JINR—D-10-11-84-818, pp 261-263) **Complex of programs for calculating the systems for charged particle beam transport and shaping.** Nagaenko, M.G. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad, USSR). 1985. (In Russian). NTIS (US Sales Only), PC A16/MF A01. File Number DE87780164. (CONF-8309402—).

From 5. international meeting on problems of mathematical simulation, programming, and mathematical methods for solving the physical problems; Dubna, USSR (20 Sep 1983).

Three programs for calculating the systems of beam transport and shaping in charged particle accelerators are described. The BETRAMF program is used for calculating the magnetic optical systems in a linear approximation. The basis of the program mathematical techniques is formed by calculations of the matrices of particle coordinate transformation during beam transport through every element of a channel. The TOREX program calculates the aberration factors of the second and third orders on the basis of numerical integration of the dynamic equations with specially selected initial conditions and application of the difference formulae for differentiation with high-order accuracy. The MARTLET program is meant for numerical simulation of the effect of aberrations of second order on the shape of the beam phase volume, its radial dimensions, as well as for optimization of the systems in the second order to reduce the beam radial distortions. All the programs are constructed of separate modules. Unformatted recording of numbers is used that facilitates their coding and decreases the error probability. A part of initial data is set in a symbolic form. The calculation results are output in the form of tables suitable for further use and analysis. 3 refs.

41755 (JINR—D-10-11-84-818, pp 312-314) **Software for the system of data acquisition, processing and displaying for a heavy ion collective accelerator.** Dubovik, L.V.; Inkin, V.I.; Saenko, T.P. 1985. (In Russian). NTIS (US Sales Only), PC A16/MF A01. File Number DE87780164. (CONF-8309402—).

From 5. international meeting on problems of mathematical simulation, programming, and mathematical methods for solving the physical problems; Dubna, USSR (20 Sep 1983).

The software structure for a multicomputer system realizing the data acquisition and displaying functions, as well as checking up the parameters of the KUTI-20 heavy ion collective accelerator is considered. The system includes the SM-4 minicomputer, "Electronika-60" microcomputer, KM001 microcomputer and CAMAC equipment. At present the algorithms of data acquisition, processing and displaying are realized for different accelerator subsystems. The developed system is used in maintenance and start-up works at the KUTI-20 accelerator and in the course of its operation. 3 refs.

41756 (JINR—D-10-11-84-818, pp 166-168) **Specific features of mathematical simulation of space field in magnetostatics.** Dojnikov, N.I.; Lamzin, E.A.; Simakov, A.S.; Sychevskij, S.E. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad, USSR). 1985. (In Russian). NTIS (US Sales Only), PC A16/MF A01. File Number DE87780164. (CONF-8309402—).

From 5. international meeting on problems of mathematical simulation, programming, and mathematical methods for solving the physical problems; Dubna, USSR (20 Sep 1983).

The specific features of statement and solution of space boundary-value problems of magnetostatics using a modified scalar potential are discussed. Two algorithms applied in calculations of a dipole electromagnet for storage and accelerator facilities and an electromagnet for a large hadron spectrometer are discussed in brief. 12 refs.

41757 (JINR—D-10-11-84-818, pp 372-374) **Extension of operational systems in computers of common use for application in systems for experimental equipment control.** Demidov, M.A.; Makarov, V.V.; Solov'ev, G.N. (Moskovskij Inzhenerno-Fizicheskij Inst., USSR). 1985. (In Russian). NTIS (US Sales Only), PC A16/MF A01. File Number DE87780164. (CONF-8309402—).

From 5. international meeting on problems of mathematical simulation, programming, and mathematical methods for solving the physical problems; Dubna, USSR (20 Sep 1983).

The problems of constructing specialized software for large complexes of experimental equipment and its functioning with serial operating systems (OS) are discussed. The main concepts being the base of dispatching software construction (an applied program package) extending the ES OS potentialities being used in the IHEP system for automatic data acquisition and accelerator control are considered. 2 refs.

41758 **(JINR-R—1-86-403) Reconstruction of neutron energy spectra by calorimetric measurements on 4pi channel of the Serpukhov accelerator.** Balandin, V.P.; Belogorlov, E.A.; Vorob'ev, A.P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1986. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702826.

The measuring and reconstruction methods of the neutron spectra in the 4pi neutral particle channel of the Serpukhov accelerator are described. It is shown that the result based on this method gives a good agreement with the neutron spectrum determined by the charge exchange reaction. The monitoring procedure of the beam during real experiments on the BIS-2 spectrometer is proposed. 8 references, 5 figures.

41759 (JINR-R—13-86-492) Module for control and synchronization of a setup used for nuclear emulsion irradiation in a strong magnetic field. Buriev, N.T.; Voevodin, M.A.; Kaplin, V.I.; Kovalenko, A.D.; Sajfulin, Sh.Z. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1986. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702841.

Camac module for synchronization of units of a setup for nuclear emulsion irradiation in a strong magnetic field in relativistic nuclei beams of the synchrophasotron is described. The module makes it possible to obtain standard synchro-pulses for three independent channels with a delay of 500 ms and an alignment step of 50 ns. The blocking of channel triggering according to the logic required is provided for. 5 references, 4 figures.

41760 (LBL—22203) The SuperHILAC heavy ion intensity upgrade. Feinberg, B.; Brown, I.G. (Lawrence Berkeley Lab., CA (USA)). Mar 1987. Contract AC03-76SF00098. 7p. (CONF-870302—162). NTIS, PC A02. File Number DE87009328.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

A high current MEtal Vapor Vacuum Arc (MEVVA) ion source is to be installed in the third injector (Abel) at the SuperHILAC, representing the first accelerator use of this novel ion source. The MEVVA source has produced over 1 A of uranium in all charge states, with more than 100 electrical mA (emA) of U^{4+}. Transport of the space-charge dominated beam through the charge-state analysis dipole will be enhanced by a 100 kV extractor voltage and neutralization by secondary electrons. In addition to the MEVVA source, other improvements already in place include a lower pressure in the Low Energy Beam Transport line (15.8 keV/AMU) to reduce charge exchange for the heavy elements, and the addition of a second 23 MHz buncher upstream of the Wideroe linac and two 70 MHz bunchers between the 23 MHz Wideroe and the 70 MHz Alvarez linacs. The project is expected to result in a fivefold increase in beam delivered to Bevatron experiments, increasing the extracted uranium beam to 5×10^7 ions/pulse.

41761 (LBL—23160) Status of ECR [Electron Cyclotron Resonance] source technology. Lyneis, C.M. (Lawrence Berkeley Lab., CA (USA)). Mar 1987. Contract AC03-76SF00098. 16p. (CONF-870302—204). NTIS, PC A02/MF A01; GPO Dep. File Number DE87010974.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

ECR (Electron Cyclotron Resonance) ion sources are now in widespread use for the production of high quality multiply charged ion beams for accelerators and atomic physics experiments, and industrial applications are being explored. Several general characteristics of ECR sources explain their widespread acceptance. For use with cyclotrons which require CW multiply charged ion beams, the ECR source has many advantages over heavy-ion PIG sources. Most important is the ability to produce higher charge states at useful intensities for nuclear physics experiments. Since the maximum energy set by the bending limit of a cyclotron scales with the square of the charge state, the installation of ECR sources on cyclotrons has provided an economical path to raise the energy. Another characteristic of ECR sources is that the discharge is produced without cathodes, so that only the source material injected into an ECR source is consumed. As a result, ECR sources can be operated continuously for periods of weeks without interruption. Techniques have been developed in the last few years, which allow these sources to produce beams from solid materials. The beam emittance from ECR sources is in the range of 50 to 200 π mm-mrad at 10 kV. The principles of ECR ion sources are discussed, and present and future ECR sources are reviewed.

41762 (SAND—87-0056C) RADLAC-II module accelerator development for double pulse injector operation. Jones, E.E.; Smith, D.L.; Mazarakis, M.G.; Jojola, J.M.; Hasti, D.E.; Lehmann, M.R. (Sandia National Labs., Albuquerque, NM (USA); Ktech Corp., Albuquerque, NM (USA)). Jun 1987. Contract AC04-76DP00789. 4p. (CONF-870656—3). NTIS, PC A02. File Number DE87010743.

From 6. Institute of Electrical and Electronic Engineers pulsed power conference; Arlington, VA, USA (29 Jun 1987).

The RADLAC-II Module (RIIM) accelerator has been converted to a double-pulse accelerator with a foilless diode injector load. The diode/injector performance has been addressed in the double-pulse operation mode using two machine configurations to compare two voltage regimes. In both cases, a gas phenomenon appears to inhibit the generation of a second electron beam. The higher voltage single-pulse mode injector configuration produces a 20 to 30 kA, 4 MV, 40 ns electron beam. The primary areas of interest include: first pulse coupling and interference with the second pulse water switches, second pulse water switch jitter, additional losses of the second pulse, and injector plasma shorting between pulsed for separations less than 2 ms.

41763 (SAND—87-0239C) Pulsed power safety and technical training at Sandia National Laboratories. Goldstein, S.A.; Zawadzkas, G.A.; Donovan, G.L.; Mikkelson, K.A.; Sharpe, A.W.; Johnston, R.R. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 13p. (CONF-870656—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011318.

From 6. Institute of Electrical and Electronic Engineers pulsed power conference; Arlington, VA, USA (29 Jun 1987).

The expansion of pulsed power applications research at Sandia National Labs requires increasing technician-level support from individuals trained in high voltage, short pulse technology. Large superpower generators need a broad-based training curriculum in all aspects of accelerator operation to satisfy recent Department of Energy (DOE) desires for formal certification of accelerator operators. This paper discusses the status of Sandia's safety and technical training program in pulsed power technology directed mainly towards high school graduate and technical school level students. Present safety training methodology requires that hazards for experimental facilities are identified first, a specific curriculum is then tailored to individuals' background experiences and hazards involved with their current assignments. In the technical training program, certification requirements are being established and a coursework program has been initiated in which subjects are organized into two sections. The first covers electrical principles and physical properties of pulsed power components. The second presents various support-type subsystems for accelerators.

41764 (SAND—87-0495C) Laser trigger system for the Hermes-III accelerator. Hamil, R.A.; Woolston, T.L.; Ramirez, J.J.; Schanwald, L.P.; Clark, B.F.; Corley, J.P.; Johnson, D.L.; Cowen, P.J. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 3p. (CONF-870656—11). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011312.

From 6. Institute of Electrical and Electronic Engineers pulsed power conference; Arlington, VA, USA (29 Jun 1987).

The laser trigger system for the twenty, 2.2-MV rimfire switches in the Hermes-III accelerator is being installed and tested at Sandia National Laboratories. The laser is a modified commercially available 0.9-J KrF laser whose output is divided into twenty beams. Each beam is optically delayed for the purpose of proper switch timing and is then directed to the SF_6 insulated high voltage gas switch. The alignment system provides a convenient, reliable, low-cost method of aligning the KrF laser beam with the twenty switches. The optical system, consisting of seventy individual components, is environmentally protected and mounted on rigid structures to assure the alignment. In addition to design information, preliminary triggering test data are discussed.

41765 (SLAC-CN—357) Radiation measurements in the North arc: November 1986 through April 1987. Jenkins, T.M.; Benson, E.; Ipe, N.; Gearhart, R.A. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). 12 May 1987. Contract AC03-76SF00515. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010650.

This paper is an effort to share preliminary data on radiation measurements. Measurements were made using passive lithium-flouride thermoluminescent dosimeters (TLD) placed in the North arc during the start-up period of the Stanford Linear Collider (SLC). Li-7 dosimeters were used for ionizing radiation measurements, and Li-6 dosimeters moderated by polyethylene were used for measuring neutrons. In addition, some measurements were made

near alcove N-6 using a Cs-137 gamma-ray source in order to determine the effectiveness of the 2 inch lead wall placed at the entrance to the alcove. When it became apparent that significant doses were being recorded at some alcoves, Pb walls were put in front of those electronic racks and Pb was put in the magnets. The Pb (approximately 1/2 inch square) in the magnet gaps was placed only on those magnets where the gap faces the aisle, and typically was put on four such magnets upbeam of each alcove and three such magnets downbeam of the alcoves. Vertical profiles were made on the photon dose at the entrance to alcove N-3 before and after the Pb was added to the magnets. Measurements were also made in front of and behind the 2 inch thick Pb wall. In addition, measurements were made of the transmission of photons in Pb using spheres of different wall thickness. Finally, neutron fluences were measured at a few selected alcoves (N-1, N-3 and N-15T). Only one of these was made in the shadow of a Pb wall.

41766 **(SLAC-PUB—4028) DC septum magnets for the damping rings of the SLC SLAC Linear Collider.** Bijleveld, J.; Peterson, J.M.; Jensen, D. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Jul 1986. Contract AC03-76SF00515. 6p. (CONF-870901—1). NTIS MF A01; 2; GPO Dep. File Number DE87008330.

From 10. international conference on magnet technology (MT-10); Boston, MA, USA (21 Sep 1987).

The injection/extraction systems of the 1.21 GeV Stanford Linear Collider (SLC) damping rings uses four pairs of water cooled septum magnets. Each pair consists of a thin-septum, low-field (3 mm, 3 kilogauss) magnet plus a thick-septum, high-field (12 mm, 8 kilogauss) model. In the latest design cooling reliability was improved by using stainless-steel tubing imbedded in the copper. The operating current in each is 2600 amperes, at a density of up to 120 amperes per mm^2. Plasma-sprayed alumina is used to provide electrical insulation. The magnet system is compatible with 10^{-9} torr ultra-high vacuum. The magnet design, fabrication, and measurements are described.

41767 **(SLAC-PUB—4229) Beam diagnostics and control for SLC.** Ross, M.C. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Feb 1987. Contract AC03-76SF00515. 4p. (CONF-870302—193). NTIS, PC A02. File Number DE87010317.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Construction of the SLAC Linear Collider has posed some new problems in beam diagnostic device design. Typical beam sizes are small when compared with conventional storage rings, orbit tolerances are tighter and the pulsed nature of the machine means that signal to noise enhancement by averaging is not always possible. Thus the diagnostics must have high resolution, high absolute accuracy and must deliver data from a single pulse. In practice the required performance level depends on the function and dynamics of a given region in the collider. This paper reviews the major beam diagnostic systems and then discusses the global data acquisition schemes. Each system is described only in a very cursory fashion.

41768 **(SLAC-PUB—4247) Progress report on new rf breakdown studies in an S-band structure at SLAC.** Wang, J.W.; Loew, G.A. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Feb 1987. Contract AC03-76SF00515. 4p. (CONF-870302—199). NTIS, PC A02. File Number DE87010316.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

This paper gives a progress report on RF breakdown studies carried out at SLAC on an S-band standing-wave disk-loaded accelerator structure. The structure is the same as described at two earlier conferences but it has been equipped with eight new radial probes and one output port to observe the emission of light, which has not yet been used. The earlier breakdown limit of 144 MV/m equivalent traveling-wave accelerating gradient and 312 MV/m peak surface field has been reached again and possibly exceeded slightly even though the disk iris edges are severely pitted from earlier tests. Using the new probes it has become possible to monitor field emission as a function of azimuthal direction as well as to record the signals generated at the instant of breakdown. Results are given together with some information on the condition of the structure, chemical cleaning and RF processing. The paper ends with the presentation of some speculations and future plans.

41769 **(SLAC-PUB—4262) Performance of the SLAC Linear Collider klystrons.** Allen, M.A.; Fowkes, W.R.; Koontz, R.F.; Schwarz, H.D.; Seeman, J.T.; Vlieks, A.E. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). 1987. Contract AC03-76SF00515. 3p. (CONF-870302—196). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010544.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

There are now 200 new, high power 5045 klystrons installed on the two-mile Stanford Linear Accelerator. Peak power per klystron averages over 63 MW. Average energy contribution is above 240 MeV per station. Electron beam energy has been measured as high as 53 GeV. Energy instability due to klystron malfunction is less than 0.2%. The installed klystrons have logged over one million operating hours with close to 20,000 klystron hours cumulative operating time between failures. Data are being accumulated on klystron operation and failure modes with failure signatures starting to become apparent. To date, no wholesale failure modes have surfaced that would impair the SLAC Linear Collider (SLC) program.

41770 **(TRI-PP—87-9) H^- injection for the TRIUMF KAON Facility.** Mackenzie, G.H. (TRIUMF, Vancouver, British Columbia (Canada)). Feb 1987. 8p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87900856.

TRIUMF proposes to construct a KAON Factory based on the acceleration of 100 μA of protons from 0.45 to 30 GeV by means of two synchrotrons. The first, the Booster synchrotron, would operate at 50 Hz and would be filled with protons accumulated in a storage ring of the same size and located in the same tunnel. This Accumulation ring in turn will be filled by protons injected continuously over $\sim$20 ms by stripping H^- ions extracted from the TRIUMF cyclotron. Analytic calculations and a simulation program show that such accumulation is feasible and that a beam for Booster injection may be prepared by suitably programming changes in injected beam parameters and ring closed orbit position during injection. Such a technique should allow stripper lifetimes of several hours. The simulation program has also been used for brief studies on acceleration and on internal targets. The cyclotron must be modified to provide extracted H^- beams. A program has started and electrostatic deflector efficiencies of 85% have been measured with beams of 20 μA equivalent current.

41771 **(TRI-PP—87-26) Efficient extraction of H^- ions from the TRIUMF cyclotron.** Mackenzie, G.H.; Laxdal, R.E.; Dutto, G.; Pearson, J.B.; Worsham, R.; Zach, M. (TRIUMF, Vancouver, British Columbia (Canada)). Mar 1987. 3p. (CONF-870302—239). NTIS (US Sales Only), PC A02/MF A01. File Number DE87900865.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The TRIUMF cyclotron can produce sufficient cw H^- flux for charge exchange injection into a 100 μA KAON factory but was designed for extraction by H^- stripping. A program at TRIUMF has successfully demonstrated that direct extraction may be achieved by driving a radial resonance with rf electric field and by shielding the deflector septum with a narrow foil. An electrostatic deflector generated a 10 mm wide beam-free region between an extractable H^- beam and the circulating beam at the location of a magnetic channel septum. The average beam power was low (450 W) but the peak intensity equivalent to 20 μA cw. An 85% transmission was measured, the remaining 15% being foil stripped into an existing beam line. Further improvements are expected, especially after the operation of an additional accelerating cavity (2 x 150 kV at 120 kW) presently under construction. The extracted H^- ions will be accumulated by extended multiturn charge exchange injection into a dedicated ring. The results of recent dynamics simulations and equipment studies are presented.

41772 **Emittance studies of high intensity negative ion sources equipped with continuous surface cylindrical and spherical geometry tungsten ionizers.** Alton, G.D.; McConnell, J.W.; Tajima, S.; Nelson, G.J. (Oak Ridge National Lab., TN). *Nuclear Instruments and Methods in Physics Research, Section B: Beam Interactions with Materials and Atoms;* **24/25**: No. 2, 826-833(Apr 1987). (CONF-861114—).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

A digitally controlled emittance measurement, data acquisition and processing system has been designed, implemented and used to determine emittances of negative ion beams extracted from high intensity negative ion sources equipped with cylindrical and spherical geometry cesium surface ionizers. Comparative studies indicate that the emittances of ion beams extracted from the source equipped with a spherical geometry ionizer are lower by 13-21% than those extracted from the source equipped with a cylindrical geometry ionizer. This difference may be attributable to geometric factors rather than differences in the sizes of the emission areas at the points of negative ion generation. Studies reveal that the emittances of these sources are independent of ion mass for most of the materials investigated and independent of ion current over the range of ion currents used in these investigations (4-12 μA).

41773 **Applications of the MEVVA high current metal ion source.** Brown, I.G. (Lawrence Berkeley Lab., CA). *Nuclear Instruments and Methods in Physics Research, Section B: Beam Interactions with Materials and Atoms;* **24/25**: No. 2, 841-844(Apr 1987). (CONF-861114—).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

A new kind of ion source has been developed in which a Metal Vapor Vacuum Arc (MEVVA) is used to produce the plasma from which the ion beam is extracted. The novel and exciting feature of this source is the very high metal ion beam current attainable. A total ion beam current of over 1 Ae has been extracted from the embodiment of the concept that we are presently using, and this is not a limit of the method. The source was developed to upgrade the uranium ion beam intensity of the Bevatron, LBL's heavy ion synchrotron, for basic nuclear physics research. Other important applications include its use within the Heavy Ion Fusion research effort; for ion implantation; and for other basic research uses. In this paper the source is described briefly, its performance outlined, and its potential and limitations for a variety of applications is discussed.

41774 **Use of molybdenum ion source electrodes at RTNS-II.** Massoletti, D.J.; Harter, G.A.; Heikkinen, D.W. (Lawrence Livermore National Lab., CA). *Nuclear Instruments and Methods in Physics Research, Section B: Beam Interactions with Materials and Atoms;* **24/25**: No. 2, 852-854(Apr 1987). (CONF-861114—).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Results are reported for an ongoing effort to optimize D^+ beam production by the MATS-III ion source used at RTNS-II. The three seven-aperture electrodes, originally consisting of water-cooled copper, have now been tested using uncooled molybdenum and with water cooling on the second (decel) electrode only. Details of the change, the results of the testing, and the benefits in operation, performance and cost are given.

41775 **Oxide cathode lifetime improvements at RTNS-II.** Massoletti, D.J. (Lawrence Livermore National Lab., CA). *Nuclear Instruments and Methods in Physics Research, Section B: Beam Interactions with Materials and Atoms;* **24/25**: No. 2, 855-857(Apr 1987). (CONF-861114—).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Also published as report UCRL—94798; CONF-861114—14-10.

Results are reported for an ongoing effort to optimize D^+ beam production by the MATS-III ion source used at the RTNS-II. The oxide cathode assembly originally designed for lower power operation has been modified and redesigned for higher electron current yield, longer life and serviceability. A factor of 2.5 has been gained in cathode lifetime due to these changes. The details of the changes and results and benefits in operation and performance are given. In addition, the technique used for manufacture of the filament is described.

41776 **Atlas positive-ion injector project.** Pardo, R.C.; Bollinger, L.M.; Shepard, K.W. (Argonne National Lab., IL). *Nuclear Instruments and Methods in Physics Research, Section B: Beam Interactions with Materials and Atoms;* **24/25**: No. 2, 746-751(Apr 1987). (CONF-861114—).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

The goal of the Argonne Positive Ion Injector project is to replace the ATLAS tandem injector with a facility which will increase the beam currents presently available by a factor of 100 and to make beams of essentially all elements including uranium available at ATLAS. The beam quality expected from the facility will be at least as good as that of the tandem based ATLAS. The project combines two relatively new technologies - the electron cyclotron resonance ion source, which provides ions of high charge states at microampere currents, and rf superconductivity which has been shown to be capable of generating accelerating fields as high as 10 MV/m resulting in an essentially new method of acceleration for low-energy heavy ions.

41777 **Brazing techniques for side-coupled electron accelerator structures.** Hansborough, L.D.; Clark, W.L.; DePaula, R.A.; Martinez, F.A.; Roybal, P.L.; Wilkerson, L.C.; Young, L.M. (Los Alamos National Lab., NM). *Nuclear Instruments and Methods in Physics Research, Section B: Beam Interactions with Materials and Atoms;* **24/25**: No. 2, 863-867(Apr 1987). (CONF-861114—).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

The collaboration between the Los Alamos National Laboratory and the National Bureau of Standards (NBS), started in 1979, has led to the development of an advanced cw microtron accelerator design. The four 2380-MHz NBS accelerating structures, containing a total of 184 accelerating cavities, have been fabricated and delivered. New fabrication methods, coupled with refinements of hydrogen-furnace brazing techniques described in this paper, allow efficient production of side-coupled structures. Success with the NBS RTM led to Los Alamos efforts on similar 2450-MHz accelerators for the microtron accelerator operated by the Nuclear Physics Department of the University of Illinois. Two accelerators (each with 17 cavities) have been fabricated; in 1986, a 45-cavity accelerator is being fabricated by private industry with some assistance from Los Alamos. Further private industry experience and refinement of the described fabrication techniques may allow future accelerators of this type to be completely fabricated by private industry.

41778 **White neutron source from 1 to 400 MeV.** Wender, S.A.; Lisowski, P.W. (Los Alamos National Lab., NM). *Nuclear Instruments and Methods in Physics Research, Section B: Beam Interactions with Materials and Atoms;* **24/25**: No. 2, 897-900(Apr 1987). (CONF-861114—).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

A new high-intensity white neutron source has recently been constructed at Los Alamos. Beams of neutrons with a continuous energy distribution up to several hundred MeV are produced by the spallation reaction using the 800-meV pulsed proton beam from the Los Alamos Meson Physics Facility (LAMPF) linear accelerator. The neutron facility has been designed to make very efficient use of the LAMPF beam with several experiments being able to operate simultaneously. Typical running conditions involve approximately 50 000 bursts/s and proton beam currents of 2.5 μA. Experiments planned for this fall include gamma-ray production, neutron induced fission, and medium energy (n,p) and (p,n) studies.

41779 **Design for a high intensity slow positron facility using forward scattered radiation from an electron linear accelerator.** Hulett, L.D. Jr.; Lewis, T.A.; Alsmiller, R.G. Jr.; Peelle, R.; Pendyala, S.; Dale, J.M.; Rosseel, T.M. (Oak Ridge National Lab., TN). *Nuclear Instruments and Methods in Physics Research, Section B: Beam Interactions with Materials and Atoms;* **24/25**: No. 2, 905-908(Apr 1987). (CONF-861114—).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

A tungsten moderator will be placed behind the target of the Oak Ridge Electron Linear Accelerator (ORELA) to convert gamma radiation to slow positrons. These will be extracted and led through evacuated solenoids to an experiment room. A Penning trap will be used to extend the slow positron pulses to achieve duty factors of 10% or greater. The facility will be used for atomic and molecular physics studies, positron microscopy, and materials research. Operations will be inexpensive and will not interfere with the normal function of ORELA, the measurement of neutron cross sections by flight-time spectrometry.

41780 **Production of short-lived radiopharmaceuticals for PET.** Schlyer, D.J. (Brookhaven National Lab., Upton, NY). *Nuclear Instruments and Methods in Physics Research, Section B: Beam Interactions with Materials and Atoms;* **24/25**: No. 2, 925-927(Apr 1987). (CONF-861114—).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Research projects currently being undertaken in the area of positron emission tomography (PET), require the use of very high specific activity radiopharmaceuticals. The cyclotron targetry necessary to produce near carrier free radiopharmaceuticals has posed some interesting and challenging problems in target design and construction. Radionuclides are produced at Brookhaven from gas, liquid and solid targets. Each of these phases of matter has its own special problems associated with it. Besides the normal design considerations such as heat transfer, density reduction and beam scattering, other factors such as radiation damage to metal surfaces, surface wetting angles, transport line materials and solder fluxes must also be taken in account in the design of the target. The most difficult target in which to maintain the isotopic purity has proven to be the ^{11}C from nitrogen gas target. The most difficult target in which to maintain the chemical form and reactivity over long periods of time is the ^{18}F from ^{18}O water target. These targets and the design consideration which went into them are discussed in detail.

41781 **Development of a polarized deuterium target by spin exchange with optically pumped K.** Young, L.; Holt, R.J.; Green, M.C.; Kowalczyk, R.S. (Argonne National Lab., IL). *Nuclear Instruments and Methods in Physics Research, Section B: Beam Interactions with Materials and Atoms;* **24/25**: No. 2, 963-966(Apr 1987). (CONF-861114—).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

The development of a polarized internal target at an electron storage ring is of great interest for studies in nuclear physics. The deuterium nuclei acquire polarization via the hyperfine interaction after electron spin exchange with optically pumped potassium vapor. A high power laser which covers the entire Doppler width and hyperfine splitting of the $^2S_1 2/-^2P_1 2/$ transition in potassium has been developed. Spin relaxation rates for potassium on various wall coatings have been measured. A dri-film surface has been shown to preserve polarization (>100 bounces), be long-lived at elevated temperatures, and to be efficient at preventing deuterium recombination.

41782 **Intense lithium ion beam diagnostic using the inverse nuclear reaction D(^{7}Li,n)^{8}Be.** Leeper, R.J.; Kim, K.H.; Hebron, D.E.; Wing, N.D.; Norbeck, E. (Sandia National Labs., Albuquerque, NM; Iowa Univ., Iowa City). *Nuclear Instruments and Methods in Physics Research, Section B: Beam Interactions with Materials and Atoms;* **24/25**: No. 2, 695-697(Apr 1987). (CONF-861114—).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

The decision to employ high voltage lithium ion beams on the 100 TW PBFA-II accelerator has prompted the investigation of using the inverse nuclear reaction D(^{7}Li,n)^{8}Be as an intense beam diagnostic. The diagnostic scheme operates by utilizing the high energy neutrons that are emitted from the D(^{7}Li,n)^{8}Be reaction when a ^{7}Li beam is incident upon a target containing deuterons. These high energy neutrons can in turn induce the $^{63}CU(n,2n)^{62}Cu(\beta^+)$ reaction. The amount of 9.74 min ^{62}Cu activity formed can then be measured and related to the total number of ^{7}Li in the beam. The results of calibration runs using ^{7}Li beams accelerated to energies from 1 to 32 MeV are summarized.

41783 **Antiproton production and accumulation for a 20 TeV p-bar collider.** Lambertson, G.R.; Leemann, C.W. (Lawrence Berkeley Lab., Berkeley, CA 94720). pp 338-340 of Proceedings of the 1982 DPF summer study on elementary particle physics and future facilities. Donaldson, R.; Gustafson, R.; Paige, F. Washington, DC; National Science Foundation (1982). (CONF-8206116—). Contract AC03-76SF00098.

From DPF summer study on elementary particle physics and future facilities (APS); Aspen, CO, USA (28 Jun 1982).

The feasibility of producing, collecting and cooling p-bar's at a rate > 3 . 10/sup 8/s/sup -1/ is demonstrated. This implies a filling time of — 12 hours to reach a luminosity of ≅10/sup 32/cm/sup -2/s/sup -1/ in the collider. Stochastic cooling is capable of providing a flux of — 3 . 10/sup 8/ p-bar/second, adequate to fill a 20 TeV collider in — 12 hours for operation at L ≅ 10/sup 32/cm/sup -2/s/sup -1/. This represents an order of magnitude improvement over the FNAL-source design goal. It is made possible mainly due to higher bandwidth (4 GHz vs. 1 GHz) and a lower psi/sub max//psi/sub max/ ratio (350 vs. — 10/sup 4/). Systems operating in the 4-8 GHz band are necessary, a technology which goes beyond the 2-4 GHz systems presently under development, but appears within reach with a moderate R and D effort. Stochastic cooling in the 8-16 GHz range holds the promise of small transverse emittance (≦ 1 μm normalized), allowing even shorter filling times or the use of lower field, larger circumference colliders, should such devices prove more cost-effective.

4304 Storage Rings

REFER ALSO TO CITATION(S) 41726, 42417, 42681

41784 **(ANL-HEP—87-30) Power supplies for the ring magnets of the Synchrotron X-ray Source at ANL.** Praeg, W.; McGhee, D. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 4p. (CONF-870302—215). NTIS, PC A02. File Number DE87011507.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

For the storage ring (SR) a stability of +-10 ppM is required for the main bending and focusing magnets; for the correction magnets, the requirements range from +-100 ppM for sextupole to 300 ppM for dipole magnets. The main dipole magnets are connected in series and energized from a 12-phase power supply. All other magnets have individual pulse-width-modulated (PWM) power supplies. The load of the 1436 PWM power supplies on the ac line is distributed as evenly as practicable. For the power supplies of the bending and focusing magnets of the injector synchrotron, stringent requirements are met for flat injection and ejection currents and for current tracking during acceleration.

41785 **(ANL-HEP-CP—87-21) Improvement of the dynamic aperture in Chasman Green lattice design light source storage rings.** Crosbie, E.A. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 4p. (CONF-870302—209). NTIS, PC A02. File Number DE87011509.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The Chasman-Green half cell illustrates a typical electron or positron storage ring lattice specifically designed for photon beams from undulators and wigglers located in each dispersion-free straight section. The need for a small particle beam emittance requires that the horizontal phase advance per cell should be in the neighborhood of 0.9 x 2π. Necessary chromaticity correcting sextupoles, S/sub D/ and S/sub F/, located in the dispersion straight

section introduce non-linear perturbations which limit the dynamic aperture because of amplitude dependent tune shifts. Two families of sextupoles, S_1 and S_2, can be introduced into the dispersion-free region to moderate the more harmful effects of S/sub D/ and S/sub F/. The nature of the perturbations are discussed and some guidelines for the adjustment of S_1 and S_2 sextupoles are given.

41786 **(BNL—39896) Trapped ions and beam lifetime in NSLS [National Synchrotron Light Source] storage rings.** Chou, T.S.; Halama, H.J. (Brookhaven National Lab., Upton, NY (USA)). Mar 1987. Contract AC02-76CH00016. 4p. (CONF-870302—222). NTIS, PC A02. File Number DE87011303.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Ion trapping observed in most electron storage rings causes various degree of deleterious effects both on brightness and on beam lifetime. Ion trapping is worst in the initial stages of operation when pressure due to synchrotron desorption is high. Based on these observations, various theories to explain the phenomenon have been developed. Depending on specific machines and on the seriousness of their problem, individualized cures have been adopted to eliminate or to cope with ion trapping. It is fair to say that the present understanding of ion trapping is incomplete partially due to lack of quantitative comparison between theory and experimental investigation and partially due to very different behavior among various machines. Preliminary results are presented of continuous studies to understand the ion trapping mechanism in the National Synchrotron Light Source (NSLS) electron storage rings.

41787 **(CONF-870302—216) Undulator tunability and synchrotron ring energy.** Viccaro, P.J.; Shenoy, G.K. (Argonne National Lab., IL (USA)). Mar 1987. Contract W-31109-ENG-38. 4p. NTIS, PC A02. File Number DE87011506.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Both the photon energy of an undulator as well as its tunability are determined by the period, λ, of the device, the magnetic gap, G (which is larger than the minimum aperture required for injection and operation of the storage ring), and the storage ring energy, E/sub R/. Given the photon energy, E/sub p/, the above parameters ultimately define the limits of operation or tunability of the undulator. In general, the larger the tunability range, the more useful the device. Therefore, for a given required maximum photon energy, it is desirable to find the operating conditions and device parameters which result in the largest tunability interval possible. This paper investigates the question of undulator tunability with emphasis on the role of the ring energy in order to find the smallest E/sub R/ consistent with the desired tunability interval and photon energy. As a guideline, we have included a preliminary criteria, concerning the tunability requirements for the Advanced Photon Source (APS) to be built at Argonne. The analysis is aimed at X-ray undulator sources on the APS but is applicable to any storage ring.

41788 **(KEK—85-15) Observation of the undulator radiation from the positron beam.** Maezawa, Hideki. (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Feb 1986. 7p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702654.

A spectral measurement of the 1st harmonic of the undulator radiation emitted from positron beam was made on Dec. 21, 1985 during a test operation of the Photon Factory storage ring with the 2.5 GeV positron beam which was stored up to 5.5 mA. In comparison to the same measurement performed with the electron beam, no appreciable difference in the spectral properties of the undulator radiation was found between the two cases under the condition of the low beam current of a few mA.

44 INSTRUMENTATION

REFER ALSO TO CITATION(S) 42883

4401 Radiation Instrumentation

REFER ALSO TO CITATION(S) 40484, 40857, 41410, 41681, 42245, 42246, 42311, 42311, 42424, 42433, 42440, 42547

41789 **(CEA-CONF—8729) MESS: a small-angle high resolution neutron spin echo spectrometer installed on a neutron guide of the Orphee reactor.** Papoular, R.J.; Millet, R.; Rosta, L.; Mezei, F. (Laboratoire Leon Brillouin, Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Oct 1986. 10p. (CEA-DPh-G-LLB-SDN—86-45; CONF-8610245—2). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752254.

From Workshop on neutron physics; Budapest, Hungary (8 Oct 1986).

A new small-angle, high resolution Neutron Spin Echo (NSE) spectrometer, MESS, has been built using both novel devices and new developments such as - a conceptually new velocity-selector, a polarizer which intercepts a large solid angle and operates in transmission geometry, an XY-position sensitive detector, and the Maximum Entropy Method of Data Analysis. A gain of 4 in the spectral resolution as well as a gain of 2 in the spatial one is expected over the IN11 spectrometer at the Institut Laue Langevin. First tests have been successfully carried out and NSE echoes were obtained.

41790 **(EFI—798(25)-85) Organization of readout and storage of information from an experimental setup working on-line with the ES-1022 computer.** Avakyan, Eh.O.; Avetisyan, A.Eh.; Eganov, V.S.; Oganesyan, M.A.; Sukiasyan, Yu.Z. (Erevanskij Fizicheskij Inst. (USSR)). 1985. 14p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702673.

A system for readout and transmission to the ES-1002 computer of data from and experimental setup comprising up to 32 analog-to-digital converters is constructed. As a communication line with the computer a punched tape input is utilized. The system has been used for measuring the parameters of photoproduction reactions induced in the beam of polarized photons of the Erevan Synchrotron. 3 references, 6 figures.

41791 **(EFI—824(51)-85) Optimum segmentation of a target for nuclear interaction length measurements.** Amatuni, Ts.A.; Samossyan, Kh.N. (Erevanskij Fizicheskij Inst. (USSR)). 1985. 16p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702676.

The statistical accuracy of nuclear interaction range estimation from the distribution of interaction points inside a segmented target composed of alternating layers of absorbers and detectors is studied. It is shown that for a given number of target segments the thickness of the absorber layers can be optimized which provides almost limiting statistical accuracy of measurements. 4 references, 4 figures, 1 table.

41792 **(EFI—847(74)-85) Increasing the accuracy of hadron-nucleus interaction characteristics measured by an ionization calorimeter at energies ≧ 1.0 TeV.** Sokhoyan, S.O. (Erevanskij Fizicheskij Inst. (USSR)). 1985. 16p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702697.

A technique of correct determination of the first hadron interaction which initiates nuclear-electromagnetic cascade in a calorimeter substance (Fe) is reported. A method of nuclear-cascade curve reduction by means of interpolation of experimentally observed descerete points of the energy absorption function is suggested. The method allows to increase essentially the accuracy of measurement of such nuclear-electromagnetic cascade characteristics as the total number of relativistic particles, the depth of the first maximum and the centre of gravity. 8 references, 6 figures, 1 table.

41793 **(IFVE-OEA-OEIPK—86-107) HOMER1-device for processing high-space resolution objects.** Goncharov, V.A.; Zotov, A.Yu.; Kistenev, Eh.P. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 13p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702741.

General characteristics are given and the design of a three-dimensional scanning and measuring semiautomatic device with optical and TV image reception (HOMER1) designed at the IHEP on the basis of the UIM23 microscope is considered. The device is equipped by a mini-computer with a unified electronic equipment for control. The device permits to operate with four removable image enlargements and to carry out scanning and measuring images reconstructed from holograms or fixed in a transluent medium. Measurements are based on precision slighting (coincidence of a bubble image center and measuring cross-hairs) in XY plane with simultaneous bringing (along Z axis) the enlarged television image of the local section of the reconstructed image volume. The device provides the accuracy in measurements according to x,y coordinates - 5 μm, according to Z - 70 μm. Efficiency of the image processing is 2 hologram/hour. 11 references, 4 figures.

41794 **(IFVE-OEF—86-109) Modular hadron calorimeter.** Binon, F.; Brikman, K.; Buyanov, V.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702742.

A large hodoscope hadron calorimeter of a cellular type made of autonomous modules, total absorption counters (the iron-scintillator sandwich) with wavelength shifter read-out, is described. The detector characteristics have been studied with the 200 GeV hadron beam. The detector enables one to measure the energy and the coordinates of a large number of particles simultaneously. 16 references, 7 figures.

41795 **(IFVE-OEF—86-148) SKOCh modified parameters and data processing method.** Abramov, V.V.; Baldin, B.Yu.; Vasil'chenko, V.G. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 13p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702743.

Characteristics of a modified Cherenkov radiation ring spectrometer variant (SKOCH) are presented. Methods of experimental data processing are described. Different SKOCH optics variants are investigated. Multi-particle registering electronic equipment for data read-out from SKOCH providing for the improvement of multiparticle occurance registration conditions is applied in the course of measurements using proton beams. A system of SKOCH spectrometer data processing programms is developed and experimentally tested. Effective algorithm for calibrating Cherenkov radiation ring spectrometers with quite a large angular and radial aperture is developed. The on-line- and off-line-processing program complex provides for the complete control of SKOCH operation during statistics collection and for particle (π, K, P) identification within 5.5-30 GeV/c range. 7 references, 9 figures, 3 tables.

41796 **(IFVE-ONF/OEA—86-179) System of drift tubes of the Sigma-M installation.** Denisov, D.S.; Eroshin, O.V.; Medovikov, V.A.; Musienko, Yu.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702746.

Investigation results of the drift characteristics of the proportional tubes of 29 mm inner diameter are presented. Pure methane is used as the operating gas. Maximum deviation of the measured space-time relationship from the linear one does not exceed 0.3 mm. A simple time-of-digital converter to measure the electron drift time is described. The basic parameters of the system consisting of 608 drift tubes are presented. The coordinate resolution is 0.5 mm and is due to the detecting electronics. The on-line control of the drift tubes operation and the off-line data processing are considered. 10 references, 7 figures.

41797 **(INIS-BR—625) Thermoluminescent dosimetry: production of dosimetric materials.** Campos, L.L. (Associacao Brasileira de Ensaios Nao Destrutivos, Sao Paulo). 1986. 2p. (In Portuguese). (CONF-8609282—2-Summ.). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702756.

From 1. non destructive testing congress for Latin America and Caribbe; Sao Paulo, Brazil (21 Sep 1986).

Published in summary form only.

41798 **(INIS-BR—654) Iterative inversion of the data from gamma or alpha spectrometry.** Nordemann, D.J.R. (Sociedade Brasileira de Geofisica, Rio de Janeiro). 1985. 1p. (In Portuguese). (CONF-8511295—1-Summ.). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702762.

From 1. regional meeting of geophysics; Sao Jose dos Campos, Brazil (27 Nov 1985).

Published in summary form only.

41799 **(INIS-BR—657) Infinite planar sources for gamma spectrometer calibration.** Barreto, P.M.C. (Sociedade Brasileira de Geofisica, Rio de Janeiro). 1985. 1p. (In Portuguese). (CONF-8511295—4-Summ.). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702765.

From 1. regional meeting of geophysics; Sao Jose dos Campos, Brazil (27 Nov 1985).

Published in summary form only.

41800 (INIS-mf—10916, pp 1014) **Routine postal control of X-ray units with thermoluminescent dosimeters.** Zarand, P.; Polgar, I.; Katona, E. (Weil Emil Korhaz-Rendeloeintezet, Budapest, Hungary). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

From 14. international cancer congress; Budapest, Hungary (21 Aug 1986).

41801 **(ITEF—151(1986)) Measuring ionization density of particle tracks in liquid hydrogen bubble chamber.** Perepelitsa, V.F. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1986. 19p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702810.

Methods of determining ionization density of particle tracks in a bubble chamber based on measuring track element lengths are described. The accuracy of measuring ionization density that may be obtained by means of these methods runs into 4-5%. Such an accuracy permits to identify π^+ mesons from protons upto 2.5 GeV/s with assurance. 5 references, 2 figures.

41802 **(JAERI-M—86-137) Alanine dosimeter molded with polystyrene.** Kojima, T.; Tanaka, R.; Morita, Y.; Seguchi, T.; Yoshida, K. (Japan Atomic Energy Research Inst., Tokyo). Sep 1986. 25p. (In Japanese). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702620.

Alanine dosimeter is based on electron spin resonance measurement of radiation-induced free radicals in alanine. Alanine dosimeter molded with polystyrene (PS-alanine dosimeter) has been developed for precise gamma-ray dosimetry covering wide range of dose, 2 - 10^5 Gy. The dose response is linear up to 5 x 10^4 Gy and the precision is +- 1% for the dose range 10^2 - 10^5 Gy and +- 2% for 5 - 10^2 Gy. The dose response slightly depends on temperature during irradiation and the temperature coefficient is 0.29 %/ deg C at 25 deg C in the range of temperature, -40 deg C — +50 deg C. Radiationinduced free radicals are very stable under the normal storage condition (25 deg C, relative humidity 60%) and the decay of the radicals is estimated to 2%/4 years by the accelerated aging at high temperature.

41803 **(JEN—583) Scinfi II, a program to calculate the standardization curve in liquid scintillation counting.** Grau Carles, A.; Grau Malonda, A. (Junta de Energia Nuclear, Madrid (Spain)). 1985. 39p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87702650.

A code, Scinfi II, written in Basic, has been developed to compute the efficiency-quench standardization curve for any beta radionuclide. The free parameter method has been applied. The program requires the standardization curve for ^{3}H and the polynomial or tabulated relating counting efficiency as figure of merit for both ^{3}H and the problem radionuclide. The program is applied to the computation of the counting efficiency for different values of quench when the problem is ^{14}C. The results of four different computation methods are compared. 17 references, 3 figures.

41804 **(JINR—13-86-328) Proportional chamber of the secondary particle spectrometer in the GIPERON installation.** Davydov, Yu.I.; Semenov, A.A.; Knapik, J. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1986. 5p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702817.

Multiwire proportional chambers with the effective area of 512x512 mm and 1024x1024 mm have been developed, constructed, tested and are now used in physical experiments. The chambers have standardized construction, the step of the sensitive wires is 2 mm, anode-cathode spacing is 6 mm. The detectors have been tested in the IHEP accelerator beam. The chambers have high-voltage plateau about 400 V with 100 ns strobe width. 7 references, 8 figures.

41805 (JINR—D-10-11-84-818, pp 333-336) **Programs for calibrating data processing in the presence of large distortions.** Bogdanova, N.B.; Gadjokov, V.I.; Ososkov, G.A.; Prikhod'ko, V.I. 1985. (In Russian). NTIS (US Sales Only), PC A16/MF A01. File Number DE87780164. (CONF-8309402—).

From 5. international meeting on problems of mathematical simulation, programming, and mathematical methods for solving the physical problems; Dubna, USSR (20 Sep 1983).

A program package for calibrating TV measuring systems of track detectors is described. The calibration procedure consists in measuring coordinates of some restricted number of reference points (crosses) located on a calibration grid with a known configuration. At the first stage the original algorithm for taking into account local nonlinearities forming the cross lines is realized. At the second stage the available systems of base polynomials are added by a new one, and a flexible change-over of the systems used is realized. As a result multiple improvement in the calibrating program fast-response is reached at higher accuracy of the transformations found. 6 refs.

41806 (JINR—D-10-11-84-818, pp 278-280) **Total-absorption spectrometer simulation and its energy resolution study.** Zhigunov, V.P.; Platonov, V.G.; Spiridonov, A.A.; Shestermanov, K.E. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1985. (In Russian). NTIS (US Sales Only), PC A16/MF A01. File Number DE87780164. (CONF-8309402—).

From 5. international meeting on problems of mathematical simulation, programming, and mathematical methods for solving the physical problems; Dubna, USSR (20 Sep 1983).

The program for simulating events in total-absorption spectrometers (calorimeters) is described in brief. The calculations carried out by the Monte Carlo method includes simulation of neutrino interactions, hadron and electromagnetic cascades in the real three-dimensional geometry. The program is used in experiment planning, as well as in studying the dependence of the device energy resolution on its structure. 3 refs.; 2 figs.

41807 (JINR—D-10-11-84-818, pp 11-22) **Main real time software for high-energy physics experiments.** Tikhonov, A.N. 1985. (In Russian). NTIS (US Sales Only), PC A16/MF A01. File Number DE87780164. (CONF-8309402—).

From 5. international meeting on problems of mathematical simulation, programming, and mathematical methods for solving the physical problems; Dubna, USSR (20 Sep 1983).

The general problems of organization of software complexes, as well as development of typical algorithms and packages of applied programs for real time systems used in experiments with charged particle accelerators are discussed. It is noted that numerous qualitatively different real time tasks are solved by parallel programming of the processes of data acquisition, equipment control, data exchange with remote terminals, data express processing and accumulation, operator's instruction interpretation, generation and buffering of resulting files for data output and information processing which is realized on the basis of multicomputer system utilization. Further development of software for experiments is associated with improving the algorithms for automatic recognition and analysis of events with complex topology and standardization of applied program packages. 9 refs.

41808 (JINR—D-10-11-84-818, pp 70-79) **Architecture of the computer-graphics software in two-level control system for high-energy physics experiments.** Govorun, N.N.; Evsikov, I.I.; Ivanchenko, I.M.; Karpenko, N.N.; Kirillov, D.A.; Mojsenz, P.V.; Pal'chik, V.V. 1985. (In Russian). NTIS (US Sales Only), PC A16/MF A01. File Number DE87780164. (CONF-8309402—).

From 5. international meeting on problems of mathematical simulation, programming, and mathematical methods for solving the physical problems; Dubna, USSR (20 Sep 1983).

The specific features of software meant for image generation and display in real time systems used for high-energy physics experiment control are considered. The software is constructed as a four-level hierarchy system. Prompt control of image forming and displaying is realized in an instruction language. The system under consideration realized on the basis of a ES computer is used for data output onto a display with storage tubes and a microprocessor video terminal in experiments at the U-70 accelerator. The described software is characterized by mobility, easy mastering, using and adapting to specified conditions. 10 refs.; 3 figs.

41809 (JINR—D-10-11-84-818, pp 85-90) **On some trends in developing software for chamber experiments.** Ivanov, V.G. 1985. (In Russian). NTIS (US Sales Only), PC A16/MF A01. File Number DE87780164. (CONF-8309402—).

From 5. international meeting on problems of mathematical simulation, programming, and mathematical methods for solving the physical problems; Dubna, USSR (20 Sep 1983).

Different stages and trends in developing software of systems for processing chamber snapshots taken in high-energy physics experiments are considered. The principles of organization of programs with dynamic memory distribution realized in the HYDRA system are discussed. The HYDRA system is used in JINR for processing snapshots taken in various track detectors. Introduction of the given system has permitted to provide different laboratories with identical systems of programs, considerably promote and simplify the process of program adapting for new computers, improve development and updating of programs for chamber experiments, realize regular program exchange between various research groups and simplify the procedure of experimental data exchange between them, as well as create conditions for active participation of users in developing programs for local task solution. 27 refs.

41810 (JINR—D-10-11-84-818, pp 285-287) **Bias methods in experimental nuclear physics.** Loktionov, A.A. (AN Kazakhskoj SSR, Alma-Ata. Inst. Fiziki Vysokikh Ehnergij). 1985. (In Russian). NTIS (US Sales Only), PC A16/MF A01. File Number DE87780164. (CONF-8309402—).

From 5. international meeting on problems of mathematical simulation, programming, and mathematical methods for solving the physical problems; Dubna, USSR (20 Sep 1983).

The problems dealing with detection of the studied objects, measurements of their parameters and classification at a significant background level are considered from the unified positions of the Bias method. Such problems are typical for high energy physics and they are encountered, in particular, in filtering the data during processing of photographs taken by radiation detectors. 11 refs.

41811 (JINR—D-10-11-84-818, pp 318-320) **General structure of the GRAND program for analysis of the data from a neutrino detector.** Zhigunov, V.P.; Kulikov, V.A.; Mukhin, S.A.; Naumov, V.L.; Platonov, V.G.; Spiridonov, A.A.; Ivanchenko, I.M.; Karpenko, N.N.; Mojsenz, P.V.; Pal'chik, V.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij; Joint Inst. for Nuclear Research, Dubna, USSR). 1985. (In Russian). NTIS (US Sales Only), PC A16/MF A01. File Number DE87780164. (CONF-8309402—).

From 5. international meeting on problems of mathematical simulation, programming, and mathematical methods for solving the physical problems; Dubna, USSR (20 Sep 1983).

The general structure of the GRAND (Global Result Analysis for Neutrino Detector) program used for geometrical and kinematic reconstruction of events recorded by a neutrino detector is considered. The detector consists of a calorimeter-target, a shower electron and γ detector and a magnetic spectrometer. While developing the GRAND program the multivariance (different types of the computers used), availability of various algorithms for solving the same problem, solution of separate particlular problems within the frames of one program are taken into account. The KERNLIB library and the HBOOK, ZBOOK, EPIO and FFREAD subroutine packages are used while creating the program as basic libraries.

41812 (JINR—D-10-11-84-818, pp 324-326) **General organization of a modular program system for simulating chamber experiments.** Abdurakhimov, A.U.; Govorun, N.N.; Goman, V.S.; Dirner, A.; Ivanov, V.G.; Shestakova, G.V. 1985. (In Russian). NTIS (US Sales Only), PC A16/MF A01. File Number DE87780164. (CONF-8309402—).

From 5. international meeting on problems of mathematical simulation, programming, and mathematical methods for solving the physical problems; Dubna, USSR (20 Sep 1983).

General organization of a program system used for computerized simulation of chamber experiments is considered. The system base is formed by the SIMUL, GO and THIRA modules comprising the HYDRA system. At the first stage of data processing the interaction point and particle trajectories in the chamber working volume are reproduced with regard to multiple scattering, energy losses, magnetic field and other factors. Further the spatial pattern of the event, kinematic identification and statistical analysis of the total results are made. Simulation of 1500 events and their kinematic identification on the CDC-6500 computer take about 6 min. 12 refs.

41813 (JINR—D-10-11-84-818, pp 327-329) **System for film information mathematical processing in the AS KazSSR IHEP using the BESM-6 computer.** Ivanov, V.G.; Loktionov, A.A.; Potrebennikov, Yu.K.; Slyusareva, V.B. (Joint Inst. for Nuclear Research, Dubna, USSR; Kazakhskij Gosudarstvennyj Univ., Alma-Ata, USSR; Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1985. (In Russian). NTIS (US Sales Only), PC A16/MF A01. File Number DE87780164. (CONF-8309402—).

From 5. international meeting on problems of mathematical simulation, programming, and mathematical methods for solving the physical problems; Dubna, USSR (20 Sep 1983).

The general structure of the system for mathematical processing of film information from the MIRABEL and LUDMILA hydrogen bubble chambers and the CERN 2-meter deuterium bubble chamber is considered. Data processing is realized using the BESM-6 computer with the Dubna operating system. The HYDRA and EDIT systems are used as a basis for the program development. The applied software is organized in the form of PAM files of the PATCHY system. As for the efficiency, precision characteristics, reliability and mobility the system meets the modern requirements to systems for experimental data processing in high-energy physics. 10 refs.

41814 (JINR—D-10-11-84-818, pp 330-332) **To the problem of software for film data processing process.** Balgansuren, Ya.; Buzdavina, N.A.; Glagolev, V.V.; Zaikina, A.G.; Ivanov, V.G.; Pervushov, V.V. 1985. (In Russian). NTIS (US Sales Only), PC A16/MF A01. File Number DE87780164. (CONF-8309402—).

From 5. international meeting on problems of mathematical simulation, programming, and mathematical methods for solving the physical problems; Dubna, USSR (20 Sep 1983).

The scheme of software organization developed for reducing the time of film information processing and minimizing manual labor expenditure in analysis of experimental data is considered. First the measurement results from a magnetic tape are converted into the standard format and recorded on a magnetic disc. Then geometrical and kinematic identification of events is performed. Preliminary program sorting of events is realized according to the preset criteria. After physical interpretation the data on events sorted out by an experimenter are recorded on a magnetic disc and stored there. The advantage of the considered scheme is checking of the input data and results of calculations at every processing stage using the special program. 4 refs.

41815 (JINR—D-10-11-84-818, pp 337-339) **Data compression fast algorithms and special processor for the systems of track information filmless recording.** Krushinski, D.; Ososkov, G.A.; Turzova, M. 1985. (In Russian). NTIS (US Sales Only), PC A16/MF A01. File Number DE87780164. (CONF-8309402—).

From 5. international meeting on problems of mathematical simulation, programming, and mathematical methods for solving the physical problems; Dubna, USSR (20 Sep 1983).

Special processors for data compression in systems of information filmless recording in experimental installations characterized by a high triggering frequency (streamer chambers) are described. The processors are made on the base of the K-1804 (AMD-2900) microprocessor system. A compressed representation of linear track elements with supplementary information are transmitted into the SM-4 central computer to be recorded on a magnetic tape. 7 refs.

41816 (JINR—D-10-11-84-818, pp 340-342) **On track recognition by the methods of graph theory according to the data from filmless information recording.** Ososkov, G.A.; Pakhomov, V.L.; Kozhenkova, Z.I. 1985. (In Russian). NTIS (US Sales Only), PC A16/MF A01. File Number DE87780164. (CONF-8309402—).

From 5. international meeting on problems of mathematical simulation, programming, and mathematical methods for solving the physical problems; Dubna, USSR (20 Sep 1983).

The problems of automatic event pattern recognition in track chambers according to the data of their digitizing by scanning devices using the graph theory methods are discussed. To solve a particular problem involving combination of linear track elements referring to one track projection it is proposed to introduce the distance function DIST that characterizes track element closeness to the curve being the track projection model. Introduction of this function permits to apply the algorithm for constructing the minimum connecting tree, Hamiltonian loop and Hamiltonian network for a set of linear track-elements obtained as a result of measurements. 5 refs.; 2 figs.

41817 (JINR—D-10-11-84-818, pp 343-345) **On some statistical estimations of ionization in streamer chambers.** Dvurechenskij, A.; Kulyukina, L.A.; Ososkov, G.A. 1985. (In Russian). NTIS (US Sales Only), PC A16/MF A01. File Number DE87780164. (CONF-8309402—).

From 5. international meeting on problems of mathematical simulation, programming, and mathematical methods for solving the physical problems; Dubna, USSR (20 Sep 1983).

The problem of statistical estimation of the track ionization coefficient in a streamer chamber according to the automatic measurement data with regard to the overlapping effect of streamer images and a scanning step is considered. Availability of the data on track ionization allows to identify particles in the 5-100 GeV/c momentum range. The distinctive features of using the estimations for the filmless and film information recording are discussed. 5 refs.

41818 (JINR—D-10-11-84-818, pp 346-349) **System for spectrometric data processing using the BESM-6 and ES-1060 computers.** Buttseva, G.L.; Vorob'eva, N.N.; Zav'yalova, A.S. 1985. (In Russian). NTIS (US Sales Only), PC A16/MF A01. File Number DE87780164. (CONF-8309402—).

From 5. international meeting on problems of mathematical simulation, programming, and mathematical methods for solving the physical problems; Dubna, USSR (20 Sep 1983).

The basic problems occurred while constructing operating systems for experimental data processing in high energy physics are considered using the system of spectra processing developed for the BESM-6 computer. The system under consideration includes more than 40 programs for preliminary data processing and 50 complexes of program modules for spectra unfolding. Data input-output in the system can be realized from the CDC-608, ES-5012, BESM-6 magnetic tapes, punched cards and via cable communication lines. To expand capabilities of the system its adapting for the ES-1060 computer is realized.

41819 **(JINR-R—1-86-427) Organization of a trigger system in the BIS-2 spectrometer.** Aleev, A.N.; Aref'ev, V.A.; Balandin, V.P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1986. 15p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702827.

A trigger logic of the BIS-2 spectrometer is described. The spectrometer is employed to search for and study new particles at the Serpukhov accelerator. Multiwire proportional chambers are used as main detectors of the spectrometer. The planes of the chambers are segmented electrically to form hodoscopes. These hodoscopes and also scintillation ones combined with the majority coincidence logic form the basis for the trigger system. This system made it possible to select both single particle and multiparticle events. Some characteristics of the trigger system are presented. 17 references, 4 figures, 4 tables.

41820 **(JINR-R—3-86-344) Method for identification of low-energy charged particles based on the ionization chamber with two grids.** Antonov, A.D.; Gledenov, Yu.M.; Kvitkova, N.I.; Mitrikov, M.P.; Mitrikova, R.S.; Ostrovnaya, T.M.; Tishin, V.G.; Phung Van Zuan. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1986. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702829.

For investigation of (n, p) and (n, α) reactions a method permitting to separate different sorts of charged particles under conditions of bad energy resolution is described. The ionization chamber (IC) with two grids is used as a detector of the particles. Multidimensional measuremets of amplitudes of coincidence pulses from the collector and the target and the time-of-flight spectra of captured neutrons are carried out using the measuring module on the base of the CM-3 minicomputer. The PDP-11/70 computer program for data sorting and processing are written. The operating efficiency of the proposed selection scheme is demonstrated by the measurement of the ^{6}Li(n, t)^{4}He reaction. 11 references, 4 figures, 1 table.

41821 **(JINR-R—11-86-342) Algorithms for automatic calculation of streamer track ionization in half-tone measurements.** Kulyukina, L.A.; Ososkov, G.A.; Halada, L. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1986. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702839.

The model of the streamer track image with a uniform background is considered. The simulation of half-tone measurements is made, which takes into account the effects of streamer overlapping. On the basis of this model a high-efficient algorithm for processing the obtained using the digital mode of image is suggested. The algorithm consists of the following parts: track partition into separate blobs of overlapping streamers; calculation of volumes under surface of the brightness function; smoothing the obtained curves by bellshape cubic splines; peak detecting by means of the first and second differences. The high reliability of the method was proved by testing on simulated data. 24 references, 6 figures, 1 table.

41822 **(JINR-R—13-86-456) Installation to search for events of multiple emission of delayed neutrons.** Avdeev, S.P.; Vasilenko, A.T.; Karnaukhov, V.A.; Kuznetsov, V.D.; Myshinskij, G.V.; Petrov, L.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1986. 13p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702840.

The installation designed to search for metastable nuclear states with high excitation energy (e.g. density isomers) whose decay must be accompanied with multiple emission of delayed neutrons in relativistic nucleus-nucleus collisions is described. The installation comprises beam monitoring equipment, target shifting mechanism, neutron detector and electronic system for analysis and accumulation of the incoming information in the form of distributions of detected events over neutron multiplicity and the time interval after the target exposure in the beam. The main parameters of the apparatus have been measured and the response function has been calculated. 8 references, 6 figures, 1 table.

41823 **(JINR-R—16-86-491) Energy dependences of sensitivity and errors of some neutron dosemeters.** Buchnev, V.N.; Komochkov, M.M.; Mokrov, Yu.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Dept. of Radiation Safety). 1986. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702843.

The results of experimental determination of sensitivities of the DN-A-1 and SNM-14 neutron dosimeters with combined polyethylene moderators at various neutron energies used in radiation control behind the shielding of JINR accelerators and reactors are presented. Energy dependences of sensitivities of these dosimeters are constructed. The obtained sensitivities and known neutron spectra around JINR nuclear physical installations permit to evaluate the errors of dosimeters when measuring the neutron equivalent dose in the fields with these spectra. The SNM-14 device with a combined moderator could be used as a neutron dosimeter with 30% accuracy in 0.4 eV - 20 MeV energy range. The error of the DN-A-1 device at 20 MeV energy is 40%. The results on evaluation of neutron equivalent dose over essential neutron energy range are presented. 8 references, 5 figures.

41824 **(NIKHEF-K-DIGEL—70) Pulse amplifier with high common mode rejection.** Ijlst, P. (Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie K). [1987]. 67p. (In Dutch). NTIS (US Sales Only), PC A04/MF A01. File Number DE87702849.

The input signal of a pulse amplifier contains large common-mode signals which have to be suppressed. A transformer, especially constructed for this purpose, is described. It has been tried to optimize the signal to noise ratio of the pulse amplifier by means of noise analysis. 3 references, 54 figures.

41825 **(ORNL/TM—10196) Development and evaluation of a Monte Carlo Code System for analysis of ionization chamber responses.** Johnson, J.O.; Gabriel, T.A. (Oak Ridge National Lab., TN (USA)). Jul 1987. Contract AC05-84OR21400. 119p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87011845.

This document reports on the development and testing of a Monte Carlo code system for calculating the response of an ionization chamber to mixed neutron and photon radiation environment. The code system, Monte Carlo Ionization Chamber Analysis Package (MICAP), determines the neutron, photon, and total responses of the ionization chamber to the mixed field radiation environment. The Monte Carlo method performs accurate simulations of the physical processes involved in detecting radiation using ionization chambers, and eliminates limitations inherent in approximate methods. To evaluate MICAP, comparisons were made with results obtained using other code systems and with experimental results. Separate comparisons with other code systems verified the validity of the neutron, photon, and charged particle transport processes and the nuclear models used to describe the individual neutron reactions, respectively. Comparisons with mono-energetic photon calibration experiments and with mixed neutron and photon radiation experiments verified the applicability of MICAP for analyzing the

response of ionization chambers to mixed field radiation environments. 47 refs., 23 figs., 20 tabs.

41826 **(PNL-SA—14316) Bulk environmental samples analyzed with anticosmic-shielded ultralow-background germanium detector systems.** Reeves, J.H.; Arthur, R.J. (Pacific Northwest Lab., Richland, WA (USA)). Mar 1987. Contract AC06-76RL01830. 17p. (CONF-870430—11). NTIS, PC A02/MF A01; GPO Dep. File Number DE87011144.

From International conference on methods and applications of radioanalytical chemistry; Kona, HI, USA (5 Apr 1987).

A low-level gamma-ray counting system has been developed which reduces system background (relative or other typical low-background systems) by a factor of ten in the zero to one MeV energy region, and by as much as a factor of forty at higher energies. This germanium-diode gamma-ray spectrometer was constructed for a modest investment over that required for a conventional germanium detector. The techniques involved use: (1) materials of known radiopurity to surround the diode, (2) an active external anticosmic shield to reduce the background continuum due to interactions of cosmic particles with the detector and passive lead shielding, and (3) nitrogen exhausted from the cryogenic dewar to minimize the introduction of ubiquitous radon decay nuclei into sample counting chamber. A novel method for handling samples prior to counting is presented. Also, some of the difficulties encountered in calibrating a system intended for bulk samples are discussed.

41827 (SAAS—342, pp 8-23) **Testing of measuring instruments for /sup 222/Ra and short-lived /sup 222/Ra daughter products applied in state radiation protection service and in internal health physics monitoring.** Ullmann, W. 1986. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE87780154. (CONF-8509389—Pt.2).

From Final conference on scientific-technological cooperation between the MoH of the USSR and the SAAS of the GDR; Tashkent, USSR (2 Sep 1985).

With regard to adequate experience gained by international comparisons of measuring instruments the requirements to be made on the standards for /sup 222/Ra and short-lived /sup 222/Ra daughter measurements are discussed with the description of measures to elaborate a primary or special standard of the unit of potential alpha energy concentration of short-lived /sup 222/Ra daughter products being the main point.

41828 (SAAS—342, pp 24-45) **Integrating dosemeters for the determination of the radiation exposure of miners exposed to short-lived radon daughter products.** Schwedt, J.; Feddersen, C. 1986. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE87780154. (CONF-8509389—Pt.2).

From Final conference on scientific-technological cooperation between the MoH of the USSR and the SAAS of the GDR; Tashkent, USSR (2 Sep 1985).

For the determination of the radiation exposure by short-lived radon daughters integrating measuring instruments are especially suited, because variations of activity concentrations can cause essential errors using short-term dosemeters. At present a measuring instrument based on thermluminescence detectors is used by the SAAS as a stationary area monitor. An electronic personal dosemeter with a semiconductor detector exists as a prototype. Structure and mechanism of both the measuring instruments are described and the feasibility of application in workplaces exposed to radon daughter products are discussed. Proceeding from experience gained in development and application of these instruments an outlook is given for the possibility to develop an applicable universal component system used for standardization of Ra and Ra daughter dosemeters within the CMEA.

41829 **(SLAC—298) The LASS [Larger Aperture Superconducting Solenoid] spectrometer.** Aston, D.; Awaji, N.; Barnett, B.; Bienz, T.; Bierce, R.; Bird, F.; Bird, L.; Blockus, D.; Carnegie, R.K.; Chien, C.Y. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Apr 1986. Contract AC03-76SF00515. 142p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87012351.

LASS is the acronym for the Large Aperture Superconducting Solenoid spectrometer which is located in an rf-separated hadron beam at the Stanford Linear Accelerator Center. This spectrometer was constructed in order to perform high statistics studies of multiparticle final states produced in hadron reactions. Such reactions are frequently characterized by events having complicated topologies and/or relatively high particle multiplicity. Their detailed study requires a spectrometer which can provide good resolution in momentum and position over almost the entire solid angle subtended by the production point. In addition, good final state particle identification must be available so that separation of the many kinematically-overlapping final states can be achieved. Precise analyses of the individual reaction channels require high statistics, so that the spectrometer must be capable of high data-taking rates in order that such samples can be acquired in a reasonable running time. Finally, the spectrometer must be complemented by a sophisticated off-line analysis package which efficiently finds tracks, recognizes and fits event topologies and correctly associates the available particle identification information. This, together with complicated programs which perform specific analysis tasks such as partial wave analysis, requires a great deal of software effort allied to a very large computing capacity. This paper describes the construction and performance of the LASS spectrometer, which is an attempt to realize the features just discussed. The configuration of the spectrometer corresponds to the data-taking on K^+ and K^- interactions in hydrogen at 11 GeV/c which took place in 1981 and 1982. This constitutes a major upgrade of the configuration used to acquire lower statistics data on 11 GeV/c K^-p interactions during 1977 and 1978, which is also described briefly.

41830 **(SLAC-PUB—4255) Drift chamber vertex detectors for SLC/LEP.** Hayes, K.G. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Mar 1987. Contract AC03-76SF00515. 13p. (CONF-8703128—6). NTIS, PC A02. File Number DE87011589.

From International conference on advances in experimental methods for colliding beam physics; Stanford, CA, USA (9 Mar 1987).

The short but measurable lifetimes of the b and c quarks and the tau lepton have motivated the development of high precision tracking detectors capable of providing information on the decay vertex topology of events containing these particles. This paper reviews the OPAL, L3, and MARK II experiments vertex drift chambers.

41831 **(SLAC-PUB—4318) Results from the MAC Vertex chamber.** Nelson, H.N. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). May 1987. Contract AC02-76ER00881;AC02-81ER40025;AC03-76SF00515. 33p. (CONF-8609283—1). NTIS, PC A03. File Number DE87010311.

From Workshop on vertex detectors: state of the art and perspectives; Erice, Italy (21 Sep 1986).

The design, construction, and performance characteristics of a high precision gaseous drift chamber made of thin walled proportional tubes are described. The device achieved an average spatial resolution of 45 μm in use for physics analysis with the MAC detector. The B-lifetime result obtained with this chamber is discussed.

41832 **(UND-HEP—86-AR00) New scintillating glasses for high energy physics applications.** Rogers, A.; Kinchen, B.; Baumbaugh, B.; Bishop, J.; Busenitz, J.; Cason, N.; Cunningham, J.; Gardner, R.; Mannel, E.; Mountain, R.J. (Synergistic Detector Designs, Mountain View, CA (USA); Notre Dame Univ., IN (USA). Dept. of Physics; Fermi National Accelerator Lab., Batavia, IL (USA); Levy-Hill Lab., Cheshunt, Waltham (UK)). Oct 1986. Contract AC03-84ER80146;AC02-76CH03000. 10p. (CONF-861007—28). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009753.

From Nuclear science and nuclear power systems symposium; Washington, DC, USA (29 Oct 1986).

A new family of scintillating glasses has been developed which is based upon Pr^{3+} oxide in a silicate host. The materials have fast response (30nsec $\leqq$ Tau $\leqq$ several μsec) and good opti-

cal transmission. Materials of this kind might find applicability as fiber-optic detectors for high energy physics experiments operating at moderate interaction rates.

41833 **(UND-HEP—86-RR03) A scintillating glass fiber-optic active target for vertex detection and tracking applications in high energy physics experiments.** Ruchti, R.; Baumbaugh, B.; Bishop, J.; Baumbaugh, A.; Knickerbocker, K.; Rogers, A.; Kinchen, B.; Ellis, J.; Mead, R.; Swanson, D. (Notre Dame Univ., IN (USA). Dept. of Physics; Fermi National Accelerator Lab., Batavia, IL (USA); Synergistic Detector Designs, Mountain View, CA (USA); Collimated Holes, Inc., Campbell, CA (USA)). Oct 1986. Contract AC03-84ER80146;AC02-76CH03000. 15p. (CONF-861007—29). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009754.

From Nuclear science and nuclear power systems symposium; Washington, DC, USA (29 Oct 1986).

A high resolution, fast gateable active target has been developed for Fermilab experiment E687 in order to study charm and beauty particle production and decay in high energy photon and hadron induced processes. The detector consists of a GS1 Cerium scintillating glass fiber-optic target, a multi-stage image intensifier and CCD camera system used in conjunction with a custom-built video data acquisition system. We currently detect $\leqq$ 4 photoelectrons per mm with a resolution per photoelectron of σ/sub pe/ $<$ 25 μm.

41834 **Accelerator-based mass spectrometry of methane.** Fowler, M.M.; Lysaght, P.; Wilhelmy, J.B. (Los Alamos National Lab., NM). *Nuclear Instruments and Methods in Physics Research, Section B: Beam Interactions with Materials and Atoms;* **24/25**: No. 2, 672-675(Apr 1987). (CONF-861114—).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Accelerator-based Mass Spectrometric (AMS) methods have not been generally applied to the analysis of molecular species because of difficulties with ion sources and the fact that tandem accelerators are not generally applicable. A method has been developed to measure the abundance of fully deuterated methanes, $^{13}CD_4$ and $^{12}CD_4$, in normal methane by using AMS. A low-energy electron bombardment ion source has been coupled to a single-ended electrostatic accelerator to produce positively charged molecular ions. The ions are accelerated, mass selected, and then dissociated into fragments that are detected by nuclear particle detection methods. In this way information about the composition of the original molecule, as well as the mass, is obtained. Measurements on natural neon, $^{12}CH_4$, $^{12}CD_4$, and $^{13}CD_4$ have been made, and new approaches to the stabilization of accelerator voltage and isotopic abundance calibration are presented. Possible applications for analysis of other molecules not easily measured with conventional AMS are considered.

41835 **Gated strip proportional detector.** Morris, C.L.; Idzorek, G.C.; Atencio, L.G. (to United States Department of Energy, Washington, DC). US Patent 4,654,531. 31 Mar 1987. Filed date 19 Feb 1985. vp.

This patent describes a gated strip proportional detector comprising: chamber means for intercepting a radiation beam; detector means for detecting radiation within the chamber means, the detector means having a ground plane, an anode plane having parallel anode wires thereon connected together at one end and biased to a high voltage level effective to generate a charge avalanche in response to the radiation beam. A gate plane having gate wires thereon parallel to the anode wires, and a cathode plane having cathode wires thereon orthogonal to the anode and the gate wires, the ground, anode, gate, and cathode planes being positioned in order in close parallel proximity; scanning means for sequentially energizing pairs of the gate wires in a scanning sequence effective to pass charge adjacent the pair of energized gate wires while unenergized ones of the gate wires collect charge from the charge avalanche; readout means for sequentially enabling individual wires of cathode wires orthogonal with the energized pair of gate wires to collect charge passing the energized gate wires, the readout means synchronized with the scanning means and providing an electrical output representative of the charge collected by each individual wire; display means for visibly displaying the electrical output of the readout means; and control means for providing control and synchronizing signal to the scanning means, the readout means. The display means effective to form the visible display of the display means as a two dimensional representation of the intensity of the radiation beam intercepted by the chamber means.

4402 Radiation Effects On Instrument Components, Instruments, Or Electronic Systems

REFER ALSO TO CITATION(S) 41375

4403 Miscellaneous Instruments

REFER ALSO TO CITATION(S) 40928, 41252, 41401, 41418, 41527, 41528, 41610, 41999, 42362, 42892

41836 **(CEA-CONF—8781) Channeling effects and spatial resolution in Auger electron microscopy.** Akamatsu, B.; Henoc, P.; Raouadi, K.; Celier, D.; Le Gressus, C.; Maurice, F. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI)). Aug 1986. 6p. (CONF-8608121—2). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752252.

From 11. international congress on X-ray optics and microanalysis; London, Canada (4 Aug 1986).

In Auger electron microscopy the electron probe size and the exit area of backscattered electrons limit spatial resolution. For single crystal specimen, resolution is also influenced by crystal orientation due to channeling effects. We evaluate separately channeling effects on primary beam (cross section enhancement) and effects on backscattered electrons. We present experimental results on Ga/sub 0.47/In/sub 0.53/As/InP heterojunction.

41837 **(CONF-870295—1) A portable instrument for multiple compound detection and analysis.** Buttner, W.J.; Battin, R.D.; Becker, S.E.; Domin, D.S.; Gentry, C.R.; McDowell, W.P.; Penrose, W.R.; O'Malley, S.; Stamoudis, V.C.; Stetter, J.R. (Argonne National Lab., IL (USA); Transducer Research, Inc., Naperville, IL (USA); Coast Guard, Washington, DC (USA). Office of Research and Development). 1987. Contract W-31109-ENG-38. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011486.

From Technical seminar on chemical spills; Toronto, Canada (9 Feb 1987).

In response to a need by the United States Coast Guard and other agencies to monitor levels of toxic chemical vapors frequently encountered in chemical spills, has been developed a portable toxic vapor analyzer. This instrument measures 16 independent signals (i.e., chemical parameters) and identifies and quantitates a sample by a comparison of its response to a predetermined library (so called "chemical parameter spectroscopy," or CPS). The present instrument model, which weighs ca. 9.0 Kg (including battery pack) and has dimensions of 31.5 x 32.1 x 23.5 cm, is truly portable. It has been designed to be used with only a few operator-initiated commands and has microprocessor controlled data acquisition, analysis, and identification. Moreover, emphasis was placed upon designing a rugged instrument able to easily withstand the levels of abuse likely to be encountered in the field. Prototypes have been delivered to the United States Coast Guard for evaluation.

41838 **(DOE/PC/90959—T2) Microscopic modeling of sound waves in granular material: Quarterly progress report, 4/1/87-6/30/87.** Haff, P.K. (California Inst. of Tech., Pasadena (USA)). 1987. Contract FG22-86PC90959. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012409.

Preliminary computer simulation studies have been carried out regarding several aspects of sound waves in granular materials. A simulation code has been developed in which irregular frictional particles are composed of clusters of disks, since detection of overlaps and computation of forces is especially straightforward for contacts between disks. Moreover, we anticipate that three-dimen-

sional studies will, in analogy to the present disk simulations, be most easily implemented by the construction of irregular particles out of spherical elements. Two broad categories of the acoustic properties of granular materials have been under investigation. In the first category, a collection of disks is confined under the influence of gravity, to a three-sided test cell. The fourth side of the box, consisting of a lid, or piston, is free to move up and down. The particles are allowed to come to rest after placement in the cell, and then a harmonic excitation in the form of a vertical sinusoidal oscillation is imposed upon the bottom of the test bed. An elastic disturbance propagates upward through the granular media, finally influencing the motion of the piston which rests by virtue of its own weight upon the test-cell particles. In a second line of investigation we are studying pressure fluctuations on the bed of a channel beneath a free surface grain flow. The behavior of the granular material near the wall is related to the behavior in the bulk by the boundary conditions on the flow. Thus detailed modelling of the pressure fluctuation or sound at the wall of a conduit containing flowing granular material has potential as a non-invasive diagnostic tool for grain flow.

41839 **(INIS-mf—10636) Measuring processes with opto-electronic semiconductor components.** (VDI/VDE-Gesellschaft Mess- und Regelungstechnik, Duesseldorf (Germany, F.R.)). 1985. 237p. (In German). (CONF-8502156—). NTIS, PC E15; Available from NTIS as TIB/B87-07238.

From Discussion meeting on measuring processes with opto-electronic semiconductor components; Lahnstein, F.R. Germany (6 Feb 1985).

GMR-Bericht.; no. 5.

This is a report on the state of commercially available semiconductor emitters and detectors for the visible, near, middle and remote infrared range. A survey is given on the distance, speed, flow and length measuring techniques using opto-electronic components. Automatic focussing, the use of light barriers, non-contact temperature measurements, spectroscopic gas, liquid and environmental measurement techniques and gas analysis in medical techniques show further applications of the new components. The modern concept of guided radiation in optical fibres and their use in system technology is briefly explained.

41840 (JINR—D-10-11-84-818, pp 369-371) **Software for a computer networks on the base of a broadcasting monochannel (radiochannel).** Ofengenden, S.R. (AN Ukrainskoj SSR, Kiev. Inst. Yadernykh Issledovanij). 1985. (In Russian). NTIS (US Sales Only), PC A16/MF A01. File Number DE87780164. (CONF-8309402—).

From 5. international meeting on problems of mathematical simulation, programming, and mathematical methods for solving the physical problems; Dubna, USSR (20 Sep 1983).

The structure of system software for the DISCRET 2 computer network designed for investigations in the field of nuclear physics is considered in brief. The network is constructed on the base of a broadcasting monochannel containing 2 frequency bands of 150 kHz in the UHF range, a relay station and data transfer apparatus. The channel ensures stable operation at maximum rate up to 100 kbyte/s within a radius of 50 km. 4 refs.

41841 **(JINR-R—10-86-270) System for monocrystal automatic orientation with a three-axes goniometer with stepping motors.** Nitts, V.V.; Ostrovnoj, A.I.; Ryan Kvan Kha; Sirotin, A.P.; Shirokov, V.K. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1986. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702835.

A system for monocrystal orientation is described. It permits setting precisely one of monocrystal axes (crossing of two crystallographic planes) into vertical position after preliminary visual mounting of a monocrystal of a goniometer in automatic regime. After that the crystal without violation of orientation could be attached to the edge of cryostat for further measurements. Plane position is defined by appearance of peaks in fixed windows of time spectrum. For each plane the system provides for sample setting into position with maximum of peak intensity for both planes. The search of planes goes via sequence of measurements of time spectra and turning of sample. The system is used at the IBR-2 pulsed reactor. 6 references, 1 figure, 2 tables.

41842 **(JINR-R—10-86-313) Neutron diffraction spectra registration in wave vector space coordinates. One-dimensional case.** Balagurov, A.M.; Ostrovnoj, A.I.; Shibaev, V.D. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1986. 9p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702836.

Problems related to registration in wave vector space coordinates of neutron diffraction spectra measured by the time-of-flight spectrometer. It is shown that during data acquisition squeezing of information by a factor of ten is achieved. The PVK-1 programmed time coder with the time scale corresponding to a channel width growing proportionally to time squared is used to realize this method of spectrum acquisition. The programs to control the PVK-1 coder and some CAMAC blocks for spectra measuring are described. 8 references, 4 figures.

41843 **(JINR-R—10-86-318) Controlling software for the AEhLT-2/160 system with multiprogramming capability.** Baranchuk, M.K.; Semejkin, A.Yu. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1986. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702837.

A package of drivers and programs for the link with the drivers intended for organizing a multiprogram process of measuring using the AEhLT-2/160 system is described. The drivers are developed to combine in time the processes of measuring, calculations and man-computer dialogue. 5 references, 1 figure, 1 table.

41844 **(K/QT—104) Data acquisition and control of a Raman spectrometer using a DEC PDP 11/34 computer.** Armstrong, D.P.; Fletcher, W.H.; Trimble, D.S. (Oak Ridge Gaseous Diffusion Plant, TN (USA); Tennessee Univ., Knoxville (USA). Dept. of Chemistry). Jun 1987. Contract AC05-84OT21400. 40p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011378.

The Raman spectrometer system, located at Building K-1004L, which is operated by the members of the Process Chemistry section of the Materials and Chemistry Technology Department, has recently been extensively overhauled and upgraded. A significant portion of the efforts involved in the upgrading was in the conversion to a DEC PDP 11/34 mini-computer. The necessary changes and improvements made to the laser, the optical path, the monochromator and the signal collection unit are described. The primary objective of this report is to describe the actual interfacing of the spectrometer and its interface unit to the DEC computer. In addition, the seven operating routines which were adapted for or written especially for this system are described and examples of the system's performance and flexibility are included. The resulting spectrometer system has a markedly improved performance and reliability and allows the Process Chemistry section to readily examine virtually any class of samples which may be analyzed at room temperature with argon ion laser emission lines.

41845 (N—87-21785, pp vp) **Japanese plan: Large radio heliograph in the solar max no. 22.** Enome, S. 1986. NTIS, PC A21/MF A01. (NASA-CP—2449; NAS—1.55:2449; CONF-8509317—).

From SMM topical workshop on rapid fluctuations in solar flares; Lanham, MD, USA (30 Sep 1985).

An outline as of February, 1986 is briefly described of a Japanese plan to construct a large radio heliograph in the next solar maximum. The principal performance specifications of the heliograph are 10 arsec by 10 arcsec x SEC(Zenith Distance) spatial resolution, 1 arc degree by 1 arc degree field of view, 1-sec temporal resolution, and six hour coverage of observing time. It will be operated at 17 GHz with possible other frequency of 35GHz.

41846 (N—87-21785, pp vp) **Proposed NRAO millimeter array and its use for solar studies.** Kundu, M.R. 1986. NTIS, PC A21/MF A01. (NASA-CP—2449; NAS—1.55:2449; CONF-8509317—).

From SMM topical workshop on rapid fluctuations in solar flares; Lanham, MD, USA (30 Sep 1985).

A brief summary is given of the proposed National Radio Astronomy Observatory (NRAO) Millimeter Array discussed at a

workshop held in Green Bank, W. Va., September 30 to October 2, 1985. A brief description of the solar studies that can be made with such an array is provided.

41847 **(NIKHEF-K-DIGEL—71) Tenfold frequency discriminator in NIM-cartridge.** Boes, J.C.; Es, J.T. van. (Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie K). [1987]. 14p. (In Dutch). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702850.

In this report the NIM module 860317 is described which serves for the control of frequencies at different measure points. It can cope with input signals at NIM- and TTL-level with a frequency lying inbetween 10 Hz and 100 kHz. It therefore contains 10 identical frequency measure and discrimination channels and also a measuring instrument for reading out the measured frequency on the setup trip. The module has a width of two units. 8 figures.

41848 **(NIKHEF-K-LINO—134) TERMSPEED. Manual for the use of the Commodore 8096 as terminal.** Wieman, J. (Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie K). Dec 1986. 15p. (In Dutch). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702851.

This manual describes the program Termspeed v4.gt. This program allows for using the Commodore 8096 as terminal of a Gould and for transporting data files from the Commodore floppy disk to the Gould and vice versa.

41849 **(SAND—87-0973C) Response of polyvinylidene fluoride (PVF_2) gauges to structured waveforms.** Setchell, R.E. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 4p. (CONF-870753—31). NTIS, PC A02. File Number DE87012405.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

An experimental approach is demonstrated in which the charge-stress characteristics of PVF_2 stress gauges can be examined in detail under conditions of relatively complex loading and unloading. In this approach, the gauge current and its axial stress history are measured simultaneously during the passage of a structured wave.

41850 **(SLAC-PUB—4309) Diamond-like antireflective coatings for far infrared photoconductors.** Beeman, J.W.; Nyaiesh, A.R.; Haller, E.E.; Hansen, W.L.; Garwin, E.L. (Lawrence Berkeley Lab., CA (USA); Stanford Linear Accelerator Center, Menlo Park, CA (USA)). May 1987. Contract AC03-76SF00515;AC03-76SF00098. 6p. (CONF-8706152—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012836.

From European Materials Research Society conference; Strasbourg, France (2 Jun 1987).

Diamond-like films have been used as antireflective coatings on far infrared semiconductor photoconductors. An average increase in the detector responsivity of 28% was realized for optimally coated gallium-doped germanium photoconductors compared to uncoated devices. The photoconductors were operated at 3 K without cavity in a narrow wavelength range from 98.45 to 99.35 μm. The films survived repeated thermal cycling between room temperature and 2.5 K. Any increase in dark current caused by the coating is $\leqq 10^{-14}$ A, a value which is given by instrumentation. The protective qualities of the film are explored. The potential applications of diamond-like coated photoconductors in large, unstressed and stressed arrays which will be used in future, satellite-born astrophysics missions will be discussed. 9 refs., 5 figs.

41851 **(UCID—20593) Calibration and accuracy of thermistors used in HAP test bed experiments.** Thur, W.; Blink, J.; Steinkraus, R. (Lawrence Livermore National Lab., CA (USA)). Nov 1985. Contract W-7405-ENG-48. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011917.

Small, pin-head sized thermistors are used for temperature measurement of various components and coolants in both the Zig-Zag and Gas-Cooled-Slab test beds. The temperature-dependent resistance of each thermistor is measured by driving it with a precision current source and differentially measuring the resulting voltage. In their initial installation on the ZZ test bed, these thermistors were found to be easily damaged (lead breakage) and also indicated illogical temperature relationships when readings were taken using the resistance vs temperature table provided by the manufacturer. The same type of thermistors have now been packaged and terminated in more durable 1/4 NPT fittings, and a batch of 40 have been individually calibrated at a reduced current level, resulting in acceptable accuracy for calorimetry.

41852 **(UCID—21096) Measurement and deconvolution of detector response time for short HPM pulses: Part 1, Microwave diodes.** Bolton, P.R. (Lawrence Livermore National Lab., CA (USA)). Jun 1987. Contract W-7405-ENG-48. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011912.

A technique is described for measuring and deconvolving response times of microwave diode detection systems in order to generate corrected input signals typical of an infinite detection rate. The method has been applied to cases of 2.86 GHz ultra-short HPM pulse detection where pulse rise time is comparable to that of the detector; whereas, the duration of a few nanoseconds is significantly longer. Results are specified in terms of the enhancement of equivalent deconvolved input voltages for given observed voltages. The convolution integral imposes the constraint of linear detector response to input power levels. This is physically equivalent to the conservation of integrated pulse energy in the deconvolution process. The applicable dynamic range of a microwave diode is therefore limited to a smaller signal region as determined by its calibration.

41853 (Zfl—64, pp 11) **DAPES - evaluation of measurements of the isotopic abundance in mass spectroscopy.** Hirsch, K.; Haase, G. Dec 1986. NTIS (US Sales Only), PC A03/MF A01. File Number DE87702867.

In Computer codes for problems of isotope and radiation research.

41854 (Zfl—64, pp 12) **FOPLAT - evaluation of photographically registered mass spectra.** Hirsch, K. Dec 1986. NTIS (US Sales Only), PC A03/MF A01. File Number DE87702867.

In Computer codes for problems of isotope and radiation research.

41855 **Experimental use of iteratively designed rotation invariant correlation filters.** Sweeney, D.W.; Ochoa, E.; Schils, G.F. (Sandia National Laboratories, Imaging Technology Division, Livermore, California 94550). *Applied Optics;* **26**: No. 16, 3458-3465(15 Aug 1987).

Iteratively designed filters are incorporated into an optical correlator for position, rotation, and intensity invariant recognition of target images. The filters exhibit excellent discrimination because they are designed to contain full information about the target image. Numerical simulations and experiments demonstrate detection of targets that are corrupted with random noise (SNR≈0.5) and also partially obscured by other objects. The complex valued filters are encoded in a computer generated hologram and fabricated directly using an electron-beam system. Experimental results using a liquid crystal spatial light modulator for real-time input show excellent agreement with analytical and numerical computations.

41856 **Visible near-infrared Hadamard transform spectrometer based on a liquid crystal spatial light modulator array: A new approach in spectrometry.** Tilotta, D.C.; Hammaker, R.M.; Fateley, W.G. (Department of Chemistry, Kansas State University, Willard Hall, Manhattan, Kansas 66502). *Applied Spectroscopy;* **41**: No. 5, 727-734(Jul 1987).

A stationary Hadamard encodement mask has been designed from a liquid crystal display. This mask, when properly installed and positioned in a dispersive instrument, allows the selected Hadamard encoded spectral elements to be focused on a single detector. Discussion of the advantages derived by this technique is presented.

Several emission spectra in the visible and near-infrared region demonstrate the usefulness of the Hadamard transform technique. This novel spectrometer can provide a no-moving-parts spectroscopy for future spectral applications.

45 EXPLOSIONS AND EXPLOSIVES

REFER ALSO TO CITATION(S) 42399

4501 Chemical

41857 **(LA-UR—87-2292) Spall measurements in shock-loaded hemispherical shells from free-surface velocity histories.** Cagliostro, D.J.; Warnes, R.H.; Johnson, N.L.; Fujita, R.K. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 5p. (CONF-870753—47). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013144.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

Copper and tantalum hemishells are externally loaded by a hemishell of PBX 9501 detonated at its pole. Free-surface velocity histories of the metal hemishells are measured at the pole and at 50° from the pole with a Fabry-Perot interferometer. These histories are used to determine spall strengths and depths by simple wave-interaction analyses and are compared with hydro-code (CAVEAT) predictions using simple and void-growth spall models. 8 refs., 4 figs., 1 tab.

41858 **(LA-UR—87-2466) A slow reaction rate in detonations due to carbon clustering.** Shaw, M.S.; Johnson, J.D. (Los Alamos National Lab., NM (USA)). Jul 1987. Contract W-7405-ENG-36. 5p. (CONF-870753—54). NTIS, PC A02/MF A01; GPO Dep. File Number DE87013166.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

Theoretical calculations have been made to estimate the rate of heat release due to the carbon clustering process in detonations where elemental carbon is a reaction product. The process is assumed to be diffusion limited. Diffusion constants are determined using modified Enskog theory and the Stokes-Einstein relation. The carbon cluster energy is treated by a surface correction to the bulk. The amount of energy yet to be released has an asymptotic time dependence of t/sup -1/3/. For some explosives, this leads to time dependent detonations where the effective CJ pressure is 10-20% above CJ for run distances of the order of centimeters. 9 refs., 3 figs.

41859 **(UCRL—15908) Process studies on nitroform and related compounds: Final report for period 30 January 1984 to 31 March 1987.** Frankel, M.B.; Bauerle, G.L.; Grant, L.R.; Kistner, R.L.; Lecce, J.V.; Wilson, E.R.; Woolery, D.O. II. (Rockwell International Corp., Canoga Park, CA (USA). Rocketdyne Div.; Lawrence Livermore National Lab., CA (USA)). Mar 1987. Contract W-7405-ENG-48. 66p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87012924.

Objective was to optimize a nitroform production process based on the nitration of isopropanol, and to demonstrate the product's quality by its conversion to bis(2,2-dinitro-2-fluoroethyl) formal, FEFO. The program also had a requirement for the delivery of FEFO, which had to meet specifications. All objectives were successfully achieved. A method was developed for purifying the crude solution of nitroform of its acid content without a significant loss of the product. Prior to the conversion of nitroform to fluorotrinitromethane, the nitroform was transferred to water by a novel technique, which did not involve its distillation as required by other known processes. The quality of the nitroform produced during these efforts was shown by its sequential conversion to fluorotrinitromethane, 2,2-dinitro-2-fluoroethanol and, finally, FEFO.

41860 **(UCRL—96507) Comparison of detonation velocities and average vibrational motion of atom pairs in organic explosives.** Walker, F.E.; Karo, A.M. (Lawrence Livermore National Lab., CA (USA)). 7 Jul 1987. Contract W-7405-ENG-48. 6p. (CONF-870753—55). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013104.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

Studies of the kinetics of fast condensed-phase reactions in organic systems show a reaction propagation "anomaly" in which the first-order reaction rates of many organic materials in the temperature range 3000 to 5000 K approach about $10^6\ s^{-1}$, even though the low-temperature decomposition rates are very different and the high-temperature rates are much lower than extrapolation of the Arrhenius plots would suggest. Vibrational frequencies and structural parameters obtained from infrared spectroscopy and x-ray data can be used to obtain an average velocity for the constituent atoms in the molecular system. Using Morse potential curve parameters for ten diatomic pairs, we have calculated in each case the frequencies for a number of lower-lying vibrational energy levels, corresponding to temperatures in the range from 3000 to 5000 K where detonations proceed. We discuss the apparent correlation between the detonation velocities of organic high explosives and the relative vibrational velocities and structural parameters of the bonds examined. 5 refs., 3 figs., 3 tabs.

41861 **(UCRL—96514) Energy transfer processes in condensed molecular solids: Detonation theory in a crystal: Limits.** Karo, A.M.; Hardy, J.R. (Lawrence Livermore National Lab., CA (USA); Nebraska Univ., Lincoln (USA). Behlen Lab. of Physics). Jul 1987. Contract W-7405-ENG-48. 17p. (CONF-8705106—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013111.

From International workshop on micro and macroscopic approaches to detonation; Megeve, France (31 May 1987).

We present a review of the variety of computer molecular dynamics simulations of gradually increasing complexity that have been carried out in recent years on shock propagation in condensed systems. Beginning with the simplest simulations of shocks in ordered monatomic and diatomic systems, we consider the influence of heterogeneities, such as point and line defects, voids, grain boundaries, and surfaces on the structure and stability of the shock front. We discuss our recent work on shock-induced energy transfer processes occurring in lattices containing molecular fragments or radicals, representing species of interest in the decomposition of energetic materials. The results indicate that the excitation of the intra-molecular bonds is of a broad spectral character with energy rise times essentially identical for all frequency ranges. 31 refs., 8 figs., 1 tab.

41862 **(UCRL—96795) Differential decomposition of the three ester sites in cellulose nitrate and the accelerated decomposition of highly esterified cellulose nitrates.** Leider, H.R.; Pane, A.J. (Lawrence Livermore National Lab., CA (USA)). Jun 1987. Contract W-7405-ENG-48. 23p. (CONF-8706106—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011887.

From JOWOG-12; Aldermaston, UK (29 Jun 1987).

Nitrate esters on the C_2, C_3, and C_6 positions of the anhydroglucose units of cellulose nitrate (NC) can be distinguished using high resolution Fourier transform nuclear magnetic measurements of ^{13}C. Changes in the ester population after thermal aging of NC indicate that the three ester positions have different thermal stabilities. In these experiments, the C_6-esters remained nearly unchanged on thermal aging, while the C_2-esters decomposed twice as fast as the C_3-esters. We also prepared very highly esterified NC to enhance the sensitivity of measuring the different ester types as thermal decomposition proceeded and to facilitate measurements of aging below 80°C. Almost fully esterified NC decomposed very rapidly and completely even at 60°C; less completely esterified NC (D.S. = 2.4) also decomposed very rapidly, but some samples survived. Examination revealed that the product, and thus the process, is qualitatively different from what has been observed before.

4502 Nuclear

REFER ALSO TO CITATION(S) 41275, 41916, 42715, 42892

41863 **(AD-A—179933/7/XAB) New technologies and the role of nuclear weapons in national security strategy. Volume 7. The US and European security -- interests and politics. Technical report 17, November 1982-31 December 1983.** Steiner, A. (R and D Associates, Marina del Rey, CA (USA)). 31 Dec 1983. 73p. (RDA-PH—83-11-0006M1-83G). NTIS, PC A04/MF A01.

See also Volume 8, AD-C037—536.

This chapter considers certain historical and political aspects of the security community between the US and Western Europe. The importance of Western Europe. The importance of Western Europe to the US was recognized by American policymakers for 50 years prior to the founding of NATO. The vital US interest in NATO security thus is not closely related to the brief period of overwhelming American nuclear superiority in the 1950s, but both preceded and followed that era. Recurrent NATO crises should be viewed in this light. American isolationism was never as absolute as is remembered and is unlikely to return, since its ethnic basis has been removed by world events. American volatility is a source of concern on both sides of the Atlantic, but this can be smoothed out by skillful leadership. Current arguments opposing the US guarantees to NATO are examined and found to be inadequate and unrealistic.

41864 **(AD-A—180337/8/XAB) Soviet leadership on nuclear war. Professional paper.** FitzGerald, M.C. (Center for Naval Analyses, Alexandria, VA (USA)). Apr 1987. 44p. (CNA-PP—451). NTIS, PC A03/MF A01.

Throughout the last decade, the Soviet politico-military leadership has provided startling evidence of a new Soviet doctrine on nuclear war. Leading Soviet military thinkers have themselves traced the origin of this phenomenon to evolving technological developments in both nuclear and conventional arms. In his 1982 book--Always in Readiness to Defend the Fatherland, Ogarkov used provocative language to describe recent developments in military affairs: A profound and revolutionary in the full sense of the word, perevorot (revolution, turnabout, upheaval) in military affairs is occurring in our time.... He connected this revolution with rapid quantitative developments in nuclear weapons and delivery vehicles, and with the significantly qualitative upgrading of conventional means of destruction. In his 1985 post-transfer book--History Teaches Vigilance, hereafter cited as History--he stressed that his profound and revolutionary, in the full sense of the word, perevorot is continuing in our time.... This document presents opinions on Soviet leadership in nuclear war.

41865 **(AD-A—180475/6/XAB) Just-war tradition in the nuclear age: is it ever moral to push the button. Student essay.** Carney, J.L. (Army War Coll., Carlisle Barracks, PA (USA)). 23 Mar 1987. 41p. NTIS, PC A03/MF A01.

Because of the massive destructiveness of nuclear weapons, many nuclear ethicists have asserted that their use in war is contrary to just-war traditions which have guided Western moral thought since at least the Fifth Century. This position creates a significant dilemma for US officials who must keep their fingers on the nuclear trigger as part of our national defense strategy. This essay examines the dimensions of that dilemma by reviewing the principles of the just-war tradition and applying them to modern total-war concepts. It concludes by examining three possible solutions to the dilemma, (1) deployment of a strategic defense system, such as that contemplated by SDI; (2) arms control; and (3) establishment of a world police authority under the auspices of the United Nations to enforce nuclear disarmament and to intervene, if necessary, to prevent a total conventional war between the great powers.

41866 **(AD-A—180476/4/XAB) Strategic Defense Initiative and the prisoner's dilemma. Student essay.** Kirby, D.P. (Army War Coll., Carlisle Barracks, PA (USA)). 23 Mar 1987. 32p. NTIS, PC A03/MF A01.

A Prisoner's Dilemma is a model used to assess certain situations where individuals or competitors have choices to make, the possible payoff combinations of which conform to a characteristic pattern. For nearly forty years the United States and the Soviet Union have been in a Prisoner's Dilemma as they have pursued military strategies of deterrence based in large measure on nuclear ballistic missiles. President Reagan initiated the Strategic Defense Initiative (SDI) program in 1983 in hopes that it would lead to defensive capabilities that would intercept and destroy ballistic missiles before they reached the United States and in so doing, allow the United States to adopt a military strategy based on security from ballistic missile attack. Information was gathered using a review of the literature and through analysis of the views of key military and civilian leaders, while a strong case was made for the proposition that possession of a nuclear arsenal truly does represent a Prisoner's Dilemma for the United States and the Soviet Union, the evidence did not support the proposition that SDI provides a means of escape from the dilemma.

41867 **(AD-A—995468/6/XAB) Operation Crossroads. A method for estimating the initial gamma-radiation dosage from an underwater burst of a nuclear weapon.** Young, G.A. (Naval Ordnance Lab., White Oak, MD (USA)). 20 Mar 1987. 36p. (NAVORD—4215(EX)). NTIS, PC A03/MF A01.

Extracted version of report dated 1 May 1956.

41868 **(GEPP-CB—986) Pinellas Plant facts.** (General Electric Co., St. Petersburg, FL (USA). Neutron Devices Dept.). Sep 1986. Contract AC04-76DP00656. 77p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87013100.

This plant was built in 1956 in response to a need for the manufacture of neutron generators, a principal component in nuclear weapons. The neutron generators consist of a miniaturized linear ion accelerator assembled with the pulsed electrical power supplies required for its operation. The ion accelerator, or neutron tube, requires ultra clean, high vacuum technology: hermetic seals between glass, ceramic, glass-ceramic, and metal materials: plus high voltage generation and measurement technology. The existence of these capabilities at the Pinellas Plant has led directly to the assignment of the lightning arrester connector, specialty capacitor, vacuum switch, and crystal resonator. Active and reserve batteries and the radioisotopically-powered thermoelectric generator draw on the materials measurement and controls technologies which are required to ensure neutron generator life. A product development and production capability in alumina ceramics, cermet (electrical) feedthroughs, and glass ceramics has become a specialty of the plant; the laboratories monitor the materials and processes used by the plant's commercial suppliers of ferroelectric ceramics. In addition to the manufacturing facility, a production development capability is maintained at the Pinellas Plant.

41869 **(INIS-mf—10919) Israel's position on non-proliferation.** Marom, R. (Hebrew Univ., Jerusalem (Israel). Leonard Davis Inst. for International Relations). Jun 1986. 81p. NTIS (US Sales Only), PC A05/MF A01. File Number DE87702786.

Israel maintained that the complex international system and worldwide political tension created a situation in which comprehensive plans of disarmament could not produce any positive result. The deadlock in the field of general and complete disarmament has brought Israel to the realization that one possible way to alleviate the stalemate could be progress by stages through partial measures of disarmament. Israel's position on non-proliferation indicates that the establishment of a nuclear-weapon-free-zone (NWFZ), as it relates to the Middle-East, could serve as a credible alternative to the unilateral adherence to the Non-Proliferation of Nuclear Weapon (NPT) and an effective measure of non-proliferation in the region. Contains an annotated bibliography of 186 ref.

41870 **(SAND—87-0372C) Fluid dynamics of a pressure measuring system for underground explosive tests.** Dykhuizen, R.C. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 9p. (CONF-870961—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012730.

From 4. symposium on containment of underground nuclear explosions; Colorado Springs, CO, USA (21 Sep 1987).

Numerical and analytical models are used to optimize a pressure measuring system for underground nuclear tests. This system uses a long pipe filled with gas to communicate the pressure level to a transducer in a pressure chamber remote from the explosion cavity. The pressure chamber and pipe are pressurized above the final pressure expected from the explosion. During the explosion, the high pressure gas blows down, preventing debris from entering and clogging the system. The models were first checked against the Junior Jade test series, which used an undergound non-nuclear explosion to simulate a nuclear test. It was found that the measured pressure oscillated for some time before settling down to a steady value. This is shown to be a result of an organ pipe oscillation that can develop in the short pipes used for this test series. The analytical model provided a simple means to optimize the system design parameters and showed that changing the working fluid from nitrogen to helium would improve the time response of the system significantly. The numerical model is then used to obtain more accurate predictions of the sytem response. 2 refs., 5 figs., 1 tab.

41871 **(UCRL—96960) Computer simulation studies on free surface reflection of underwater shock waves.** Kamegai, M.; Rosenkilde, C.E.; Klein, L.S. (Lawrence Livermore National Lab., CA (USA); Howard Univ., Washington, DC (USA). Dept. of Physics and Astronomy). Jul 1987. Contract W-7405-ENG-48. 11p. (CONF-870737—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013498.

From 16. shock tube symposium; Aachen, F.R. Germany (26 Jul 1987).

A computer simulation was used to study the irregular surface rarefaction phenomena produced by an underwater shock wave generated from a strong point explosion. We simulated the explosions with energies near 10^{15} joules at three depths (3 m, 21 m, and 66.5 m) and computed the shock propagation until the peak pressure decayed to less than 0.1 GPa (1 Kbar). The simulations permitted the determination of the onset point of irregular rarefaction on the surface, and of the envelope separating the irregular and regular-rarefaction regions. The theoretical predictions of the onset points are consistent with the code results for all three cases. However, the predicted region boundaries, which are calculated from the arrival of the first rarefaction signal, are in agreement with the simulation results only in the weak shock case (DOB = 66.5 m). For the strong and intermediate shock cases (DOB = 3 m and 21 m, respectively), agreement was not obtained. The implication of the discrepancy in these cases is discussed. 9 refs., 8 figs.

50 ENVIRONMENTAL SCIENCES, ATMOSPHERIC

5001 Basic Studies

REFER ALSO TO CITATION(S) 41891

41872 **(AD-A—180268/5/XAB) Validation of the OPAQUE data from the US/FRG meppen site. Scientific report No. 1, December 1985-April 1986.** Gallery, W.O.; Farmer, D.A.; Longtin, D.R. (Optimetrics, Inc., Burlington, MA (USA)). 13 May 1986. 71p. (OMI—162). NTIS, PC A04/MF A01.

Under the OPAQUE Program, visible and infrared transmittance and supporting meteorological data were taken around the clock at seven sites in Europe over a period of several years. This report describes the validation of the data taken at the US/FRG site near Meppen from Sept. 1978 to March 1980. Validation consists of two parts: editing and recalibration. First the data are edited to remove invalid data and to assign reliability values. Secondly, the IR transmittances are recalibrated based upon calculated transmittances during periods of high visibility. Several unexplained anomalies in the data were discovered and are discussed.

41873 **(CONF-8703151—Summs.) 3rd PEF status colloquium. Programme and summaries.** (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftre). Mar 1987. 81p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE87770188.

From 3. PEF status colloquium of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (10 Mar 1987).

The report presents 59 papers of the Colloquium. The following subjects were discussed: 1. Monitoring and analysis of pollutant effects on forest trees; differentiation between air pollution and other contributing factors. 2. Development and optimisation of scientific and technical measures for reducing or avoiding emissions. 3. Development of instruments and recommendations for science and policy. 4. Research into the atmospheric dispersion, transformation and deposition of airborne pollutants. 5. Interdependences between air pollution and respiratory diseases in humans.

41874 **(LA-UR—87-1464) The cross-valley structure of the nocturnal along-valley wind in Brush Creek, Colorado.** Clements, W.E.; Hoard, D.E. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 5p. (CONF-870864—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009014.

From 4. American Meteorological Society's conference on mountain meteorology; Seattle, WA, USA (25 Aug 1987).

The purpose of the study was to investigate the nocturnal katabatic wind in the valley and its morning breakup. One of the instruments, a doppler lidar operated by the National Oceanic and Atmospheric Administration's Wave Propagation Laboratory (NOAA/WPL), made detailed measurements of the along-valley component of the nocturnal katabatic wind in the valley. We have used this data to examine the cross-valley structure of this wind.

41875 **(LA-UR—87-1471) Mean physical properties of the nocturnal along-valley wind in Brush Creek, Colorado.** Clements, W.E.; Archuleta, J.A. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 8p. (CONF-870864—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009015.

From 4. American Meteorological Society's conference on mountain meteorology; Seattle, WA, USA (25 Aug 1987).

Some physical properties of the nocturnal katabatic wind in Brush Creek, Colorado, have been examined for four nights when the ridgetop wind had an upvalley component. The maximum wind speed u/sub m/ in the katabatic jet increases linearly with the surface inversion strength SIS. Furthermore, the depth and the mass flux decreases linearly with increasing ridgetop wind speed. These relationships suggests that a ridgetop wind speed of 10 to 15 m/s may completely cut off the katabatic wind.

41876 **(LA-UR—87-1704) Influence of external winds and cloudiness on the transition layer above nocturnal valley drainage.** Orgill, M.M.; Barr, S. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 6p. (CONF-870864—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010123.

From 4. American Meteorological Society's conference on mountain meteorology; Seattle, WA, USA (25 Aug 1987).

Past observations in mountain valleys during nighttime drainage conditions show the existence of a dynamically active transition layer between the locally-driven drainage flow and the upper free stream airflow. The height variations in this transition layer are analyzed with respect to external wind conditions, cloudiness, and weather. Data sets from the 1982 and 1984 Department of Energy's Atmospheric Studies in Complex Terrain (ASCOT) field experiments in Brush Creek Valley, Colorado, are used in this analysis of the transition layer.

41877 **(LA-UR—87-1745) Wind fluctuations in a nocturnal drainage flow.** Stone, G.L.; Hoard, D.E. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 7p. (CONF-870864—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010130.

From 4. American Meteorological Society's conference on mountain meteorology; Seattle, WA, USA (25 Aug 1987).

In this paper we present an analysis of wind fluctuations observed during an experiment conducted in Brush Creek valley, Colorado, in September and October 1984. We show that in this valley wind fluctuations with periods around 15 min are very energetic. Coherence studies show that these fluctuations are organized and suggest the existence of secondary cross-valley circulations in the main drainage flow. Such circulations would play an important role in transporting heat, momentum, and pollutants within the valley.

41878 **(NP—7770187) Publications referring to PEF-sponsored, terminated research programs.** (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftre). Jan 1987. 35p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE87770187.

The report lists the publications referring to PEF-sponsored research projects since 1984. The projects can be classified under the 4 headings: 1. Monitoring and analysis of air pollution effects on forest ecosystems; 2. Research into pollutant dispersion, conversion and deposition; 3. Development and optimisation for emission reduction and prevention measures; 4. Development of instruments and recommendations for the industrial and political sector.

41879 **(NP—7770189) Vertical structure of the horizontal visual range up to a height of 300 m in Northern Germany.** Pietzner, B. (Hannover Univ. (Germany, F.R.). Inst. fuer Meteorologie und Klimatologie; Hannover Univ. (Germany, F.R.). Fachbereich Physik). 1986. 142p. (In German). NTIS (US Sales Only), PC A07. File Number DE87770189.

The vertical structure of the horizontal visual range was measured continuously for two years and a half at a radio mast. Apart from visual range meters installed at six different height levels, the system comprised thermometers and dew point meters at these height levels, as well as a ceilograph. In general, the visual range was found to increase with increasing height, except in big-scale weather conditions with a low cloud base.

41880 **(NP—7770192) Fluid dynamics and microdynamics in numerical models of convective clouds.** Doms, G.; Herbert, F. (Frankfurt Univ. (Germany, F.R.). Inst. fuer Meteorologie und Geophysik). Apr 1985. 383p. (In German). NTIS (US Sales Only), PC A17. File Number DE87770192.

Numerical cloud models are to provide deeper physical and meteorological insight by a mathematical simulation of the complex dynamic mechanisms of cloud formation. The investigation was carried out with the goal of structuring cloud dynamics models without neglecting theoretical details. The theoretical models are presented (excluding numerical difference methods). Some problems were neglected (stratus clouds, fog, icing) or mentioned only in passing (aerosol effects). In spite of this, the investigation may provide important information to everybody interested in numerical cloud models.

41881 **Climate-chemical interactions and effects of changing atmospheric trace gases.** Ramanathan, V.; Callis, L.; Cess, R.; Hansen, J.; Isaksen, I.; Kuhn, W.; Lacis, A.; Luther, F.; Mahlman, J.; Reck, R.; and others. (National Center for Atmospheric Research, Boulder, Colorado Department of Geophysical Sciences, University of Chicago, Chicago, Illinois). *Reviews of Geophysics and Space Physics;* **25**: No. 7, 1441-1482(Aug 1987).

The problem concerning the greenhouse effects of human activities has broadened in scope from the CO_2-climate problem to the trace gas-climate problem. The climate effects of non-CO_2 trace gases are strongly governed by interactions between chemistry, radiation, and dynamics. We discuss in detail the nature of the trace gas radiative heating and describe the importance of radiative-chemical interactions within the troposphere and the stratosphere. We make an assessment of the trace gas effects on troposphere-stratosphere temperature trends for the period covering the preindustrial era to the present and for the next several decades. Non-CO_2 greenhouse gases in the atmosphere are now adding to the greenhouse effect by an amount comparable to the effect of CO_2. The rate of decadal increase of the total greenhouse forcing is now 3—6 times greater than the mean rate for the period 1850—1960. Time-dependent calculations with a simplified one-dimensional diffusive ocean model suggest that a surface warming about 0.4—0.8 K should have occurred during 1850 to 1980. For the various trace gas scenarios considered in this study, the equilibrium surface warming for the period 1980 to 2030 ranges from 0.8 to 4.1 K. This wide range in the projected warming is due to the range in the assumed scenario as well as due to the threefold uncertainty in the sensitivity of climate models.

41882 **Two case studies of the transport of dust storm aerosol and the potential for incorporation into precipitation.** Doty, K.G.; Semonin, R.G. (Illinois State Water Survey, Champaign, IL 61820). *Journal of Applied Meteorology;* **26**: No. 7, 763-773(Jul 1987).

To investigate the hypothesis that dust storms enhanced the calcium concentrations in precipitation in the mid-1950's, two case studies were performed for major dust events in the southern Plains of the United States during March and April of 1981. Forward trajectories were calculated from source areas of blowing dust and then compared with hourly radar summaries to see if the advected dust cloud intercepted precipitation over sites of the National Atmospheric Deposition Program. Four sites met these criteria between the two case studies and exhibited extremely high calcium concentration and deposition values for the study period.

5002 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 40360, 40361, 40362, 40363, 40364, 40365, 40366, 40367, 40368, 40369, 40370, 40371, 40372, 40373, 40374, 40375, 40376, 40377, 40378, 40379, 40380, 40381, 40382, 40383, 40384, 40385, 40386, 40387, 40388, 40389, 40390, 40391, 40392, 40393, 40394, 40395, 40436, 40441, 40455, 40459, 40611, 40791, 41203, 41205, 41210, 41254, 41497, 41499, 41575, 41600, 41929, 41939, 41955, 41984, 42011, 42257, 42258, 42270, 42277

41883 **(AD-A—180050/7/XAB) Infrared sky radiance distributions in the marine boundary layer. Interim report.** Schade, W.J.; Law, D. (Naval Ocean Systems Center, San Diego, CA (USA)). Jan 1987. 25p. (NOSC/TD—1032). NTIS, PC A02/MF A01.

This report describes an alternative method for inferring the effects of aerosols on atmospheric transmittance. Spatial distributions of infrared sky radiance in the 3- to 5-micrometer (SWIR) and 8- to 12-micrometer (LWIR) spectral bands were measured at low elevation angles above the sea surface, then compared with the corresponding clear sky radiance. The infrared aerosol transmittance was inferred from the ratio of measured radiance to calculated clear sky radiance along the horizon line of sight (LOS). Results show that only the LWIR band can be used to infer aerosol transmittance reliably. The radiance along the horizon LOS originates predominately in the lowest 100 m of the atmosphere; therefore, reasonably accurate horizon radiance of transmittance predictions could be made from meteorological data within this low altitude.

41884 **(AD-A—180263/6/XAB) Procedural guide on sick-building syndrome. Final report.** Liebhaber, F.B. (Air Force Occupational and Environmental Health Lab., Brooks AFB, TX (USA)). Mar 1987. 28p. (USAFOEHL—87-037EH0253CSI). NTIS, PC A03/MF A01.

This report offers guidance in recognizing, investigating, and abating indoor air problems. Current published literature concerning indoor quality was reviewed and combined with USAFOEHL field experience to provide a logic trail the base BEE could follow while doing a sick-building survey. In addition, this guide can also serve as a handy reference for indoor air-quality standards, sampling techniques, and questions concerning possible sick buildings.

41885 **(AD-A—180370/9/XAB) Industrial-hygiene sampling instructions. Technical guide.** Belkin, F.; Bishop, R.W. (Army Environmental Hygiene Agency, Aberdeen Proving Ground, MD (USA)). Mar 1987. 54p. (USAEHA-TG—141). NTIS, PC A04/MF A01.

This technical guide describes air and bulk industrial-hygiene sampling procedures for over 100 potentially hazardous chemical contaminants. The guide contains air volumes, sampling rates and

references for IH air sampling. It addresses the types of containers and amount of sample required for bulk samples. Procedures for submitting samples including a listing of Army laboratories that perform industrial-hygiene chemistry analysis are provided. The guide lists the expendable monitoring supplies that are compatible with the sampling procedures and includes representative commercial sources. Contents include: General Sampling Instruction; Asbestos Sampling; Crystalline Silica (Quartz) Sampling; Filter Sampling; Adsorption Tube Sampling; Impinger Sampling; Bulk Sampling; Passive (Diffusion Type) Monitor; Random Sampling; Field Blanks; Procedures for Submitting Samples.

41886 **(BNL—52027) Atmospheric deposition of nitrogen: Potential benefits to agricultural production.** Coveney, E.A.; Medeiros, W.H.; Moskowitz, P.D. (Brookhaven National Lab., Upton, NY (USA)). Nov 1986. Contract AC02-76CH00016. 40p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87012704.

Effects of indirect fertilization on agricultural lands by atmospheric deposition are examined for the four most valuable crops in the US: corn, soybean, wheat, and pasture grasses. A literature search was conducted to find suitable dose-response functions for the effects of fertilization on yield of each crop. Predicted yield changes were computed from the deposition of nitrogen to the soil in addition to nitrogen applied in accordance with current agronomic practices using these dose-response functions. Low to high nitrogen inputs from atmospheric deposition (1 to 7 kg/ha) are expected to increase the average yield of corn by 0.2 to 1.1%, soybean by 0.1 to 0.7%, wheat by 0.1 to 0.4%, and pasture grasses by 1.6 to 14%. Pasture land is predicted to receive the greatest impact because it is usually unfertilized.

41887 **(CONF-870695—5) Environmental consequences of CO_2-climate interactions: The need for integrated resource analysis.** Cushman, R.M.; Waterhouse, J.C.; Farrell, M.P. (Oak Ridge National Lab., TN (USA)). 21 Jun 1987. Contract AC05-84OR21400. 17p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87011119.

From 80. annual meeting of the Air Pollution Control Association; New York, NY, USA (1 Jun 1987).

The paper reviews various studies dealing with the results of the increasing atmospheric carbon dioxide concentration and the climatic change it will cause. The writer recommends the construction of integrated regional resource analysis models to fully understand the consequences of the CO_2 increase. (ACR)

41888 **(DPST—86-710) Methodology for predictive modeling of environmental transport and health effects for waste sites at the Savannah River Plant: Environmental information document.** Stephensen, D.E.; King, C.M.; Looney, B.B.; Grant, M.W. (Savannah River Lab., Aiken, SC (USA)). Mar 1987. Contract AC09-76SR00001. 71p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87013046.

This document provides information on the methods used to predict chemical transport and the associated health risk for various postulated closure activities at waste sites. The document was prepared as background documentation for the Department of Energy's proposed Environmental Impact Statement (EIS) on waste management activities for groundwater protection at the Savannah River Plant (SRP). The various mathematical formulations used in the environmental transport analysis, the exposure assessment, and the health risk assessment used in the analysis of all foreseeable scenarios as defined by the National Environmental Policy Act (CFR, 1986) are presented in this document. The scenarios do not necessarily represent actual environmental conditions for every SRP waste site. This document was prepared in support of the National Environmental Policy Act process, but does not by itself satisfy federal or state regulatory requirements. 29 refs., 11 figs.

41889 **(LA-UR—87-1657) Simulations of the ASCOT Brush Creek data by a nested-grid, second-moment turbulence-closure model and a kernel concentration estimator.** Yamada, Tetsuji; Bunker, S.; Niccum, E. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 6p. (CONF-870864—6). NTIS, PC A02. File Number DE87010120.

From 4. American Meteorological Society's conference on mountain meteorology; Seattle, WA, USA (25 Aug 1987).

Yamade and Bunker (1986) demonstrated that a three-dimensional hydrodynamic model, HOTMAC (Higher Order Turbulence Model for Atmospheric Circulations) reproduced nocturnal drainage flows, morning transition and convective upvalley and upslope flows observed during the 1982 ASCOT (Atmospheric Studies in COmplex Terrain) field campaign in Brush Creek, Colorado. We also showed that a Monte Carlo statistical diffusion model, RAPTAD (RAndom Particle Transport And Diffusion) driven by the outputs (mean and turbulence variables) from HOTMAC simulated well the structure of an SF_6 tracer plume and obtained a vertical profile of concentration similar to the one observed. A "Kernel" density estimator is used in this study where each particle represents a center of a puff. In this study, the concentration was recomputed by applying the Gaussian kernel estimator. A total of only 900 particles were released. The vertical profile of the modeled SF_6 concentration averaged over one hour between 6 and 7 a.m. at a site near the mouth of Brush Creek was compared with observation. The modeled and observed concentrations agreed well although the modeled values were slightly smaller than the observations for the first 250 m above the ground.

41890 **(LA-UR—87-1678) Application of a four-dimensional data assimilation technique for airflow simulations over the western intermountainous region.** Kao, C.Y.; Yamada, T. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 21p. (CONF-870864—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010122.

From 4. American Meteorological Society's conference on mountain meteorology; Seattle, WA, USA (25 Aug 1987).

We used a three-dimensional time-dependent model, together with the technique of four-dimensional data assimilation, to obtain the diurnal variations of wind, temperature, water vapor, and turbulence in a mountainous region from the west coast to east of the Rockies, and from northern Mexico to Wyoming. Tracer particles were then released in the model to study the transport and diffusion of pollutants through a Lagrangian random-particle statistical method.

41891 **(NP—7770186) Ozone measurements near the ground and in the atmosphere in the first half-year 1986.** (Deutscher Wetterdienst, Hohenspeissenberg (Germany, F.R.). Meteorologisches Observatorium). 1986. 181p. (In German). NTIS (US Sales Only), PC A09/MF A01. File Number DE87770186.

Tables are presented on surface ozone, total ozone, ozonograms, results of radioprobe measurements and monthly and daily variations of ozone and temperature in km steps.

41892 **(NP—7770226) Air pollution in medium-range mountains by pollutants concentrating below atmospheric barriers. Results of continuous measurements in the Black Forest and the Schoenbuch Forest.** Baumbach, G. (Stuttgart Univ. (Germany, F.R.). Abt. Reinhaltung der Luft). 1986. 28p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE87770226.

During windy and rainy weather there are relatively low concentrations of the gaseous air pollutants SO/sub 2/, NO/sub 2/, and NO in the forest stands of the Black Forest and Schoenbuch. When the sky is clear, inversions develop, fixing the upper limit of the mixing layer available for exhaust gas diffusion. The upper limit of the mixing layer has the greatest influence on the propagation of pollutants and acts as a barrier. In autumn and winter, the vertical extension of the mixing layer is restricted to a few hundred metres above soil owing to the reduced solar radiation. In medium-range mountains the characteristics of the mixing layer are particularly important for the diffusion of pollutants.

41893 **(PB—87-188009/XAB) Illinois Reasonable Further Progress report for 1985: ozone and carbon monoxide. Annual report.** (Illinois Environmental Protection Agency, Springfield (USA). Div. of Air Pollution Control). Sep 1986. 81p. (IEPA/APC—86-022). NTIS, PC A05/MF A01.

The document demonstrates that Illinois is making Reasonable Further Progress in reducing VOC emissions as part of its plan for reducing ozone pollution in the State. The report discusses the VOC emissions inventory for the Chicago area and the Illinois part of the St Louis area, and shows that total VOC emissions in those areas are below the levels required by RFP in 1985. The report also discusses the improvement in ozone air quality and in carbon monoxide air quality in those areas.

41894 **(PB—87-188116/XAB) Volatile organic compounds in 600 US homes: major sources of personal exposure.** Wallace, L.; Clayton, C.A. (Research Triangle Inst., Research Triangle Park, NC (USA)). May 1987. 9p. NTIS, PC A02/MF A01.

The USEPA carried out the Total Exposure Assessment Methodology (TEAM) Study (1980-85) on 600 subjects in five cities representing a total population of more than 700,000 persons. Personal exposures to all prevalent target compounds exceeded outdoor concentrations. Major sources were smoking (benzene, styrene, xylenes, and octane); using hot water (chloroform); wearing dry-cleaned clothes (tetrachloroethylene); and using moth crystals or room air deodorants (para-dichlorobenzene). Eleven of 14 occupations also showed elevated exposures to one or more chemicals (particularly aromatics). Auto related activities (lengthy commuting, filling gas tanks) were associated with increased exposures to several aromatics. Breath concentrations were significantly associated with personal air exposures but not with outdoor concentrations. Residence in major chemical-manufacturing and petroleum-refining areas did not significantly affect personal exposures.

41895 **(PB—87-188512/XAB) Destruction of dioxin-contaminated solids and liquids by mobile incineration. Final report, February 1984-February 1986.** Mortensen, H.; Sherman, A.; Troxler, W.; Miller, R.; Pfrommer, C. (Enviresponse, Inc., Livingston, NJ (USA)). May 1987. 169p. NTIS, PC A08/MF A01.

The EPA Mobile Incineration System, which consists of a kiln, secondary combustion chamber, air pollution control unit, and separate continuous stack-gas-analysis capabilities, was rigorously tested in 1982-1983 using PCB-contaminated liquids and other chlorinated organic fluids. Destruction and removal efficiencies of at least 99.9999% were consistently attained at a heat release of 10GT/hr. As a result of these favorable performance data, a project was initiated to evaluate the technical, economic, and administrative feasibility of on-site incineration of dioxin-contaminated materials. During 1984, the system was extensively modified for field use and performance-tested with a variety of uncontaminated soils and other solid wastes at the EPA facility in Edison, NJ. Based on the results of laboratory and pilot-plant studies conducted to establish optimum kiln conditions and the available literature, the EPA system was judged to be more than adequate for detoxifying dioxin-contaminated solids and liquids, and thus could be expected to accomplish a successful dioxin trial burn.

41896 **(PB—87-189544/XAB) Foliar injury, tree growth and mortality, and lichen studies in Mammoth Cave National Park. Final report, 1985-1986.** McCune, B.; Cloonan, C.L.; Armentano, T.V. (Butler Univ., Indianapolis, IN (USA). Holcomb Research Inst.). Mar 1987. 108p. (HRI—99). NTIS, PC A06/MF A01.

Foliar condition, tree growth, tree mortality, and lichen communities were studied in Mammoth Cave National Park, Kentucky, to document the present forest condition and to provide a basis for detecting future changes. Foliar injury by ozone was common on many plant species in 1985. Species showing the most injury were white ash, green ash, redbud, sycamore, tulip poplar, milkweed, and wild grape. Injury apparently depended on canopy position and vigor. Tree growth was equivocally related to visible symptoms in 1986, probably because of the low ozone levels in that year. Tree mortality rates from 1966-1985 in two natural stands were somewhat lower than mortality rates known for other midwestern woods.

41897 **(PB—87-189841/XAB) Locating and estimating air emissions from sources of chlorobenzenes.** (Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards). Sep 1986. 146p. (EPA—450/4-84/007M). NTIS, PC A07/MF A01.

To assist groups interested in inventorying air emissions of various potentially toxic substances, EPA is preparing a series of documents such as this to compile available information on sources and emissions of these substances. The document deals specifically with chlorobenzenes. Its intended audience includes Federal, State and local air pollution personnel and others interested in locating potential emitters of chlorobenzenes and in making gross estimates of air emissions therefrom. The document presents information on (1) the types of sources that may emit chlorobenzenes, (2) process variations and release points that may be expected within these sources, and (3) available emissions information indicating the potential for chlorobenzenes release into the air from each operation.

41898 **(PB—87-190633/XAB) Description of the Penn State/NCAR Mesoscale Model, Version 4 (MM4). Technical note.** Anthes, R.A.; Hsie, E.Y.; Kuo, Y.H. (National Center for Atmospheric Research, Boulder, CO (USA)). May 1987. 77p. (NCAR/TN—282-STR). NTIS, PC A05/MF A01.

The report describes a limited-area, hydrostatic, primitive equation numerical model developed by the Pennsylvania State University and the National Center for Atmospheric Research (NCAR). The model is known as the Penn State/NCAR Mesoscale Model, Version 4, or MM4. The report documents the continuous-model equations and their finite-difference analogs, the horizontal and vertical grid structures, the lateral boundary conditions, and the parameterization of physical processes in the model. These processes include surface fluxes of heat, moisture and momentum, the turbulent transport of these quantities in the planetary boundary layer and the free atmosphere, horizontal diffusion, and the release of latent heat in convective and nonconvective clouds. The report also provides references to other reports and publications that document the modeling system and applications of the system to the simulation of atmospheric phenomena.

41899 **(PB—87-190880/XAB) Multimedia approaches to assessment and management of hazardous air contaminants. Special report.** Bradow, F.V.; App, A.H. (Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Criteria and Assessment Office). Mar 1987. 122p. (EPA—600/8-87/012). NTIS, PC A06/MF A01.

Since its inception in 1969, NATO's Committee on the Challenges of Modern Society (CCMS) has been involved in environmental concerns. For 15 years, the NATO/CCMS Air Pollution Pilot Study series developed information on air-pollution-control strategies and impact modeling. The workshops would maintain the network of technical information communication which had developed through the pilot studies, and would provide a forum for considering problems of international scope. The topic in the first workshop was advanced air-pollution assessment methods and monitoring techniques. The second workshop, summarized in the report, was hosted by the Environmental Protection Agency on behalf of the United States of America. The workshop's theme was multimedia approaches to risk assessment and management of hazardous air contaminants. The workshop was designed to challenge air pollution research and control professionals to consider the broader context of environmental pollution. As many countries are beginning to understand, measures to safeguard public health and the environment will often require an integrated approach in order to be effective. The workshop offered an opportunity for exploring various countries' efforts toward developing such integrated, multimedia approaches to assessing and managing air pollutants.

41900 **(PB—87-191490/XAB) Evaluation of a convective scaling parameterization for estimating the diffusion of a buoyant plume.** Pierce, T.E. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). May 1987. 15p. (EPA—600/D-87/158). NTIS, PC A02/MF A01.

During limited-mixed convective conditions, high concentrations of air pollutants have been observed at ground-level from

buoyant plumes. Routinely-applied Gaussian plume dispersion models have difficulty simulating diffusion for these conditions. However, advances in convective scaling offer some hope for improved model formulations. The paper evaluates the usefulness of a diffusion formula proposed by Briggs. Thirty-nine hours of extensive meteorological, source, and tracer data were analyzed from the Kincaid field study. The evaluation of the Briggs formula compared to a Gaussian plume dispersion model showed better model performance.

41901 **(PB—87-191508/XAB) Effects of sampling nozzles on the particle-collection characteristics of inertial sizing devices. Final report.** Williamson, A.D.; Farthing, W.E.; Ward, T.E.; Midgett, M.R. (Southern Research Inst., Birmingham, AL (USA)). May 1987. 19p. NTIS, PC A02/MF A01.

In several particle-sizing samplers, the sample extraction nozzle is necessarily closely coupled to the first inertial sizing stage. Devices of this type include small sampling cyclones, right-angle impactor precollectors for in-stack impactors, and the first impaction stage of several cascade impactors. In a recent laboratory study of a stack-sampling cyclone with various sampling nozzles, significant perturbations were observed in the actual D_{50} when some of the nozzles were used. Some nozzles caused the D_{50} of the cyclone to be reduced from 10 micrometers to less than 6 micrometers. Several alternate nozzle designs were considered to alleviate this behavior. Simple extension of the nozzle length was sufficient to restore the 10-micrometers sampler D_{50}, but at the expense of enhanced deposition of the test-aerosol particles on the nozzle walls.

41902 **(PB—87-191516/XAB) Environmental tobacco smoke: mutagenic emission rates and their relationship to other emission factors.** Lewtas, J.; Williams, K.; Lofroth, G.; Hammond, K.; Leaderer, B. (Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.). May 1987. 9p. (EPA—600/D-87/146). NTIS, PC A02/MF A01.

The objective of this study was to evaluate the emission rates and exposure concentrations of mutagens, nicotine, and particles from cigarettes. Studies were conducted under controlled laboratory and chamber conditions as well as in personal residences. The mutagenicity of environmental tobacco smoke (ETS) was evaluated in three bioassays using two strains of Salmonella typhimurium. Strain TA98 was used in the standard plate-incorporation and microsuspension histidine reversion assays; and strain TM677 in a microsuspension forward mutation assay. The mutagenicity, expressed either per Ug particle or per Ug nicotine, appeared to be a relatively constant factor that did not vary significantly between various cigarette brands. These data are being used to model the emissions of mutagens to predict mutagenic exposure concentrations under various conditions.

41903 **(PB—87-191532/XAB) June-September, 6-9 AM, ambient-air benzene concentrations in 39 US cities, 1984-1986.** Seila, R.L. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). May 1987. 10p. (EPA—600/D-87/160). NTIS, PC A02/MF A01.

Ambient-air samples from 44 sites in 39 U.S. urban areas were collected in electropolished, stainless steel canisters on week days from 6 to 9 AM during June through September of 1984, 1985, and 1986. Not all sites were sampled all years. Samples were analyzed by capillary gas chromatography with flame-ionization detection to determine C2 to C12 volatile hydrocarbon composition. Benzene, which is carcinogenic and present in automobile exhaust and gasoline, was present in every sample. Individual sample concentrations ranged from 1.0 parts-per-billion as carbon (ppbC) to 273 ppbC. The benzene median concentrations by site and year ranged from 4.8 ppbC to 35.0 ppbC with the overall median being 12.6 ppbC.

41904 **(PB—87-191565/XAB) Measurement of oxidant precursors and their relationship to ozone formation.** Lonneman, W.A. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). May 1987. 24p. (EPA—600/D-87/151). NTIS, PC A02/MF A01.

Measurements of 0600 to 0900 AM speciated NMOC compounds obtained from 19 urban areas located throughout the United States during a 1985 sampling program are presented. The cities sampled all experienced ozone levels above the National Ambient Air Quality Standard (NAAQS) of 0.12 ppm. Speciated NMOC information is useful for both the development of photochemical ozone models and the evaluation of the sources contributing to ambient-air concentration levels. Using a simple box model it appears that NMOC composition has the greatest impact on ozone formation at the lower NMOC to NOx ratios.

41905 **(PB—87-191573/XAB) Verification procedures applied to the US EPA (Environmental Protection Agency) regional oxidant model.** Novak, J.H. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). May 1987. 15p. (EPA—600/D-87/159). NTIS, PC A02/MF A01.

Regional air-quality simulation models have been developed as research tools to gain a greater understanding of long-range transport and transformation of air pollutants and to evaluate regional-control-strategy alternatives. To ensure credibility of these complex model predictions, the performance of model codes must be verified for their adherence to theoretical formulations, accuracy of numerical algorithms, ability to reproduce observed data and sensitivity to uncertainties in input data. The paper describes the procedures used for verification of the US EPA Regional Oxidant Model. Comparisons with observed data are presented together with a brief summary of the results from two ozone-control-strategy applications. The sensitivity of the model to known uncertainties in input data is discussed in relation to its effect on air-pollution-control strategy evaluation.

41906 **(PB—87-191797/XAB) Neurobehavioral effects of environmental tobacco smoke.** Benignus, V.A. (Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.). May 1987. 28p. (EPA—600/D-87/154). NTIS, PC A03/MF A01.

In order to try to predict effects of environmental tobacco smoke, neurobehavioral effects of mainstream smoke were reviewed and, in conjunction with what is known about body uptake of components of environmental tobacco smoke, conjectures were made about the probable effect of environmental tobacco smoke. Effects of mainstream smoke differ in smokers and nonsmokers. Mainstream smoke has a beneficial effect on vigilance in habitual smokers. The effect in nonsmokers is less clear and may be disruptive. In both smokers and nonsmokers mainstream smoke produces increased tremor and reduced fine motor skills. The neurobehaviorally active substances in mainstream smoke appear to be nicotine and carbon monoxide. It appears that COHb is the more important consequence of environmental tobacco smoke for neurobehavioral effects, since nicotine levels in nonsmokers only reach a small fraction of those in smokers.

41907 **(PB—87-191839/XAB) Organic emissions from consumer products to the indoor environment.** Tichenor, B.A.; Mason, M.A. (Acurex Corp., Research Triangle Park, NC (USA)). May 1987. 19p. NTIS, PC A02/MF A01.

The paper discusses EPA studies in small environmental test chambers on a variety of building materials and consumer products. A number of test conditions are critical in effectively determining emission rates (e.g., temperature, humidity, air exchange rate, and product loading--area of sample/volume of test chamber). In addition, the effects of chamber concentration and chamber wall effects (i.e., adsorption to and desorption from surfaces) need to be determined. Finally, the age and condition of the sample affect its emission rate. All of these variables and phenomena are considered in the EPA research program.

41908 **(PB—87-193546/XAB) Continuous stirred-tank-reactor investigation of the gas-phase reaction of hydroxyl radicals and toluene.** Gery, M.W.; Fox, D.L.; Jeffries, H.E.; Stockburger, L.; Weathers, W.S. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). 1985. 27p. (EPA—600/J-85/487). NTIS, PC A03/MF A01.

Pub. in International J. of Chemical Kinetics, Vol. 17, 931-955(1985).

A continuous stirred-tank reactor (CSTR) was used to study the gas-phase reaction between HO and toluene. HO was generated by the in situ photolysis of nitrous acid. Flow-reactor operation at steady-state conditions with a residence time of 20 minutes allowed investigation of primary and very rapid secondary reactions. CSTR and batch-reactor experiments were also performed with selected products. Both gas-phase and aerosol products were identified by chromatography and mass spectroscopy, with total product yields between 55 and 75% of reacted carbon. Toluene reaction products included cresols, nitrocresols, nitrotoluenes, 3,5-dinitrotoluene, benzaldehyde, benzyl nitrate, nitrophenols, methyl-p-benzoquinone, methylglyoxal, glyoxal, formaldehyde, methyl nitrate, PAN, and CO. The fraction of HO methyl hydrogen abstraction was calculated to be 0.13 + or - 0.04. The ratio of reaction rate constants for nitrotoluene versus cresol formation from the HO adduct was calculated to be about 3.3 x 10,000. Also, the ratio of cresol formation versus O_2 addition to the HO adduct was estimated to be > or = 0.55. Comparisons of these measurements with previous values and the implications with respect to photochemical kinetics modeling of the atmosphere are discussed.

41909 **(PB—87-193611/XAB) Field-exposure study for determining the effects of acid deposition on the corrosion and deterioration of materials: description of program and preliminary results.** Flinn, D.R.; Cramer, S.D.; Carter, J.P.; Spence, J.W. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). 1985. 31p. (EPA—600/J-85/485). NTIS, PC A03/MF A01.

Pub. in Durability of Building Materials, Vol. 3, 147-175(1985).

Materials-exposure sites, fully instrumented to characterize environmental parameters related to air quality, meteorology, and rain chemistry, were established at four locations in the eastern and northeastern United States to study the effects of acid precipitation on atmospheric damage to metals, exterior paints, and building stone. A fifth, midwestern site has recently been added to the program. Utilizing short-term, seasonal, and long-term exposures, the corrosion behavior of five metal alloys (1010 carbon steel, Cor-Ten A, 3003-H14 aluminum, 110 copper, and 191 zinc) and two coated-steel products (galvanized steel and Galvalume) commonly used outdoors have been characterized using gravimetric, surface analytical, and corrosion film chemistry measurements. Monthly exposures indicate that the environments at the sites are significantly different in their effects on the metals.

41910 **(PB—87-194155/XAB) Follow-up investigation into formaldehyde concentrations in installations of certified e-1 classes of chi-board roofing elements under simulated actual conditions through the use of measurement apparatus: synopsis.** Masseus, J.W. (Bouwcentrum, Rotterdam (Netherlands)). Dec 1985. 8p. (In Dutch). (REPT—6361/1985-S). NTIS, PC PC E03/MF E01.

See also PB—87-194163.

41911 **(PB—87-194163/XAB) Follow-up investigation into formaldehyde concentrations in installations of certified e-1 classes of chip-board roofing elements under simulated actual conditions through the use of measurement apparatus.** Masseus, J.W. (Bouwcentrum, Rotterdam (Netherlands)). Dec 1985. 59p. (In Dutch). (REPT—6361/1985). NTIS, PC PC E04/MF E01.

See also PB—87-194155.

41912 **(PB—87-195459/XAB) Climatological variability in modeled maximum concentrations.** Petersen, W.B.; Irwin, J.S. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). 1985. 6p. (EPA—600/J-85/483). NTIS, PC A02/MF A01.

Pub. in Atmospheric Environment, Vol. 19, No. 5, 739-742(1985).

The paper analyzes a 17-year data base consisting of CRSTER outputs. Only the high and the high second-high (HSH) concentrations for two typical sources for the 17 years of CRSTER air quality output were investigated. Resampling techniques are used to assign probabilities of choosing the highest second-high concentration from the 17-year record assuming that one through five years of meteorological data were measured. It is not the intent of the paper to suggest that the exact probabilities estimated from this data base are universal to every city or site location. The important issue is to indicate the shortcomings in accepting as little as one year of on-site data for regulatory applications and to suggest a method that will better ensure that maximum concentrations are properly estimated.

41913 **(PB—87-195962/XAB) Respirable-dust levels in coal, metal, and nonmetal mines. Information Circular/1987.** Watts, W.F.; Parker, D.R. (Bureau of Mines, Twin Cities, MN (USA). Twin Cities Research Center). 1987. 30p. (BM-IC—9125). NTIS, PC A03/MF A01.

Library of Congress catalog card No. 86-600380.

The objectives of this report are to describe the current contents of Mine Inspection Data Analysis System (MIDAS), to report analyses of coal and noncoal mine respirable-dust samples collected by Mine Health and Safety Administration (MSHA) inspectors, and to evaluate the proposed change in the metal and nonmetal respirable dust standard from a formula based upon the percentage of quartz identified in the sample to 100 micrograms/cu m of respirable quartz. Based on samples collected by MSHA inspectors, changing the noncoal respirable-dust standard would result in 4% fewer samples with dust concentrations exceeding the standard. Analysis of respirable-coal-dust data collected by MSHA inspectors showed that mines with longwall plows or shears had the highest geometric mean concentrations (1.64 and 1.29mg/cu m, respectively). Mine operations using continuous rippers outnumbered longwall mine operations about 10 to 1 and had a geometric mean concentration of 0.66 mg/cu m.

41914 **(PB—87-198735/XAB) Criteria pollutant-emission factors for the 1985 NAPAP (National Acid Precipitation Assessment Program) emissions inventory. Final report, October 1986-May 1987.** Stockton, M.B.; Stelling, J.H.E. (Radian Corp., Research Triangle Park, NC (USA)). May 1987. 228p. NTIS, PC A11/MF A01.

This report provides emission-factor estimates for volatile organic compounds (VOCs), nitrogen oxides (NOx), and sulfur oxides (SOx) that were developed from a variety of readily available information. As part of the National Acid Precipitation Assessment Program (NAPAP), the EPA identified the need to generate emission factors for VOCs for about 1800 source classification categories (SCCs). Additionally, emission-factor development was needed for NOx, SOx, and VOCs for SCCs that states have used to report emissions. The objective of the effort was to estimate VOC emission factors for all SCCs where VOC factors were previously absent, and to develop NOx and SOx emission factors for SCCs that states had reported as emission sources.

41915 (PNL—6100-Pt.1, pp 45-46) **Aerosol technology development.** Cannon, W.C. Feb 1987. NTIS, PC A06/MF A01. File Number DE87010024.

In Pacific Northwest Laboratory: annual report for 1986 to the DOE Office of Energy Research: Part 1, Biomedical Sciences.

In this project they have developed methods and apparatus for generation, characterization and delivery of aerosols for studying the biological effects of inhaled air pollutants. They report here on continued development of electric field nebulization apparatus, an improved aerosol chamber, and on lung deposition studies in rodents. 4 figures.

41916 **(UCID—21111) Under-examined aspects of the potential environmental effects of nuclear war.** MacCracken, M.C.; Penner, J.E. (Lawrence Livermore National Lab., CA (USA)). Jul 1987. Contract W-7405-ENG-48. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013217.

In addition to destroying the area near the explosions, a nuclear war would lead to injection of a wide range of substances into the environment, both as a result of the delivery systems and explosions themselves and as a consequence of the blast, fires, and result-

ing destruction and disruption. While addressing the many remaining uncertainties concerning the effects of smoke injections on climate is the major topic of present research, there are a number of other potential impacts that could have major consequences, but which are currently poorly understood and have not yet been carefully examined. These under-examined effects include perturbations to atmospheric chemistry, the effects of injections of dust and water (which could create ice particles), the consequences of emissions from the smoldering phase of the fires, resuspension of materials due to perturbed surface conditions, and a range of other potential consequences.

41917 **(UCID—21112) Water resources in the Sacramento-San Joaquin Valley and San Francisco Bay: A proposed case study of the impacts of changing climate.** MacCracken, M.C.; Buddemeier, R.; Knox, J.B. (Lawrence Livermore National Lab., CA (USA)). Jul 1987. Contract W-7405-ENG-48. 16p. NTIS, PC A02. File Number DE87013216.

Computer-model projections indicate that the climatic response to changing atmospheric composition will lead to warmer temperatures, with shifting precipitation patterns, rising sea level, and retreating snow cover being among the more prominent changes. This proposal examines this environmental issue on behalf of the Sacramento-San Joaquin Valleys and the San Francisco Bay system - a region that is at present the most productive agricultural region of the world, a center of population, business and industry, and an exporter of water to the drier regions of southern California. We focus on the broadly defined issue of water resources. Probable reductions in precipitation and a higher snowline will limit water supplies, warmer temperatures will increase water demand, and rising sea level and consequently higher storm tides will threaten low-lying land and river channels. Under these conditions the maintenance of water supplies, water quality, and natural ecosystems will become crucial issues requiring unprecedented levels of planning, investment and coordination within and between the private and public sectors. We propose to develop a consortium approach to the research, educational, and policy issues which must be addressed in order to develop the societal framework needed to cope with this unprecedented problem.

41918 **(UCRL—15919) Detecting changes in global climate induced by greenhouse gases.** Barnett, T.P.; Schlesinger, M.E. (Oregon State Univ., Corvallis (USA); Scripps Institution of Oceanography, La Jolla, CA (USA); Lawrence Livermore National Lab., CA (USA)). 12 May 1987. Contract W-7405-ENG-48. 26p. NTIS, PC A03/MF A01; GPO Dep. File Number DE87012905.

A quantitative search for a theoretically-predicted CO_2 signal in surface air temperature data extending back to 1899 was marginally successful in a statistical sense. However, the nature of the signal-strength time series suggested this result in an artifact of large-scale decadal variations at the beginning and end of the record. Application of the "fingerprint" strategy to three different global fields of climate variables over the last 25 to 35 years showed no significant CO_2 signal. The analysis pointed up the need to use (1) model S/N ratios in selecting fields for subsequent analysis and (2) multiple fields in the detection process. Most important, we found the primary pattern of natural air temperature variability to be very similar to the expected CO_2 signal, thus suggesting the air temperature field is not the best place to attempt early detection of the CO_2 signal. By contrast, the primary pattern of natural variability and expected CO_2 signals in the ocean's surface temperature is substantially different suggesting the oceans as a low-noise environment in which to attempt early detection.

41919 **Chemistry and physics of a winter stratus cloud layer: A case study.** Daum, P.H.; Kelly, T.J.; Strapp, J.W.; Leaitch, W.R.; Joe, P.; Schemenauer, R.S.; Isaac, G.A.; Anlauf, K.G.; Wiebe, H.A. (Department of Applied Science, Environmental Chemistry Division, Brookhaven National Laboratory, Upton, New York). *Journal of Geophysical Research;* **92**: No. D7, 8426-8436(20 Jul 1987).

The chemical and physical properties of a supercooled stratus cloud layer and surrounding clear air covering southern Ontario on February 20, 1984, were studied with the objectives of identifying the processes responsible for the cloud water chemical composition. The cloud layer, which extended from circa 650 to 1050 m mean sea level, was bounded by a strong temperature inversion just at cloud top. The air below this inversion was well mixed vertically, as indicated by the near independence of concentrations of various trace gas species with altitude and by conservation of number concentration of particles from the surface to cloud top, with below-cloud aerosol number concentrations ($0.2<d<3$ μm) approximately equal to the sum of the interstitial aerosol and cloud droplet ($2<d<3$ μm) number concentrations. Fractional incorporation of aerosol sulfate into cloud water, determined by comparison of interstitial and cloud water sulfate concentrations, was in the range of 85—90%, similar to the result inferred from comparison of interstitial aerosol and cloud droplet number concentrations. Gas phase equivalent concentrations of cloud water species in the below-cloud air. These results suggest that the dominant processes determining cloud water composition in this cloud layer were nucleation scavenging of sulfate aerosol and scavenging of gaseous HNO_3, with no significant contribution from reactive scavenging processes. copyright American Geophysical Union 1987

41920 **Derivation of damage functions for atmospheric degradation of materials.** Haynie, F.H.; Lipfert, F.W. (Environmental Protection Agency, Research Triangle Park, NC). *Journal of the Air Pollution Control Association;* **37**: No. 6, 680-681(Jun 1987).

A damage function is a mathematical expression relating rates of damage or deterioration to causal conditions in the environment. There have been many attempts to derive damage functions for materials degradation, notably for metals corrosion. However, relatively little attention has been given to systematic experimental designs from first principles. This paper is intended to provide guidance for such an idealistic experimental program design.

41921 **Air quality modeling for materials damage assessment.** Dupuis, L.R.; Lipfert, F.W.; Schaedler, J.S. (Brookhaven National Lab., Upton, NY). *Journal of the Air Pollution Control Association;* **37**: No. 6, 681(Jun 1987).

An assessment of damage to materials requires detailed information on deposition of corrosive agents on spatial scales compatible with the distributions of materials in urban areas, typically less than 25 km^2. The ultimate objective is the integrated or aggregated effect across the entire metropolitan statistical area. The materials damage functions used in the NAPAP Assessment require spatial distributions of annual average gaseous SO_2 concentrations and wet deposition of hydrogen ion (H^+). In neither case are extant monitoring data adequate to characterize the necessary detail in urban areas. For lack of an alternative method, urban H^+ deposition values were assumed to be equivalent to regional values, as interpolated from various combined North American precipitation monitoring networks. However, a modeling approach was utilized to estimate the annual average SO_2 concentrations. This paper deals with the scope of the urban SO_2 modeling effort.

41922 **Distribution of materials in place.** Daum, M.L.; Lipfert, F.W.; Oden, N.L. (Brookhaven National Lab., Upton, NY). *Journal of the Air Pollution Control Association;* **37**: No. 6, 681-682(Jun 1987).

Reliable estimates of the total quantities of sensitive materials in place are necessary in order to assess the potential costs of materials damage due to air pollution and acidic deposition. Because of the large geographic areas of interest and the amount of detail required to capture the most sensitive materials, and because materials are not distributed randomly or uniformly, a stratified sampling design is required, and the results must be extrapolated to provide estimates for an entire metropolitan area. This paper describes methods developed to estimate the distribution of materials in place in the Northeastern US for use with the NAPAP materials damage assessment.

41923 **Economic evaluation of materials damage associated with acid deposition.** Horst, R.L. Jr.; Lareau, T.J.; Lipfert, F.W. (Mathtech, Inc., Princeton, NJ). *Journal of the Air Pollution Control Association;* **37**: No. 6, 682-683(Jun 1987).

The assessment approach is based on the maintained hypothesis that a reduction of acid deposition from current levels to natural background would increase the interval of time before specific materials would be repaired or replaced. The lengthening of the maintenance interval implies that annualized maintenance expenditures would be reduced and that cost savings would be realized. These cost savings represent an approximation of the willingness of individuals to pay for a reduction in acid deposition. The strength of this assessment relative to previous studies of materials damage is the disaggregate nature of the data. Estimates of damage are computed for 5-km grid squares within selected urban areas in terms of material/use combinations and building types. Four materials (paint, zinc [galvanized steel], mortar and stone), seven uses (walls, roofs, chimneys, gutters, downspouts, fencing, window trim) and four building types (single and multiple family residences, commercial/industrial buildings, and tax exempt buildings) are examined. Detailed inventory data are available for sampled areas in four case study cities: Pittsburgh, Cincinnati, new Haven, and Portland. Statistical methods based on building counts are used to extrapolate to unsampled areas in the case study cities and to other urban areas in 17 northeastern states.

41924 **Materials damage, acid deposition, and the NAPAP assessment.** Bradley, R.A. (Dept. of Energy, Washington, DC). *Journal of the Air Pollution Control Association;* **37**: No. 6, 683(Jun 1987).

Estimating the value of materials damage and determining its relationship to changing circumstances is crucial for the development of efficient and equitable control strategies and policy choices. According to the NAPAP assessment the cost of the maintenance action is determined by estimating costs for the appropriate type of maintenance. The problems associated with this approach and suggestions for increasing confidence in the NAPAP methodology are discussed.

41925 **Ozone layer depletions. Hearing before the Subcommittee on Health and the Environment of the Committee on Energy and Commerce, House of Representatives, One Hundredth Congress, First Session, March 9, 1987.** Washington, DC; Government Printing Office (1987). 660p.

A hearing on the environmental implications of ozone layer depletion over the Antarctic and other areas of the globe brought testimony from representatives of industry, space and climate research personnel, chemists, the Department of Commerce, and environmental groups and agencies. The area of most concern was predictions of increased skin cancers, eye cataracts, suppression of human immune systems, as well as reduced agricultural yields and plankton growth. The witnesses reviewed the findings of recent studies by the Environmental Protection Agency and the National Aeronautical and Space Agency and appropriate international responses to control the release of chlorofluorocarbons (CFCs) 11 and 12 into the atmosphere. Industry spokesmen argued that there are no substitutes for CFCs in some processes. Material submitted for the record follows the testimony of the 14 witnesses.

41926 **Furnace injection of dry calcitic sorbents.** Kramlich, J.C.; Pershing, D.W.; Silcox, G.D. Northridge, CA; Combustion Institute (1986). 16p. (CONF-8610180—). Combustion Institute, Western States Sect., c/o L.S. Caretto, Calif. State Univ., Northridge, CA 91330.

From Fall meeting of the Western States Section/Combustion Institute; Tucson, AZ, USA (27 Oct 1986).

Technical Paper WSS/CI 86-27.

The use of calcium based sorbents for in-boiler SO/sub 2/ control has received considerable research attention in the last few years. The principal economic limitation on the technology is the failure of the sorbent to be fully sulfated within the time available. The key is to avoid excessive raw materials charges by enhancing sorbent conversion to calcium sulfate. The two tools that are available to meet this goal, are to enhance sorbent reactivity, and to optimize the sorbent environment within the boiler. This paper discusses research directed at the first of these two aspects. The relationship between sorbent activation, structure, and reactivity is developed. The various possible relationships between CaO structure and sulfation performance are presented. Finally, the use of pressure hydration as a tool for studying the relationship between hydrate structure and reactivity is explored.

41927 **Comment on comment on Acid Precipitation in Historical Perspective and Effects of Acid Precipitation.** Richter, D.D. (Oak Ridge National Lab., TN). *Environmental Science and Technology;* **18**: No. 8, 632-634(Aug 1984). Contract W-7405-ENG-26.

This discussion is a rebuttal to A. Henriken's critique of the authors original correspondence regarding acid rain. The author states that Henriksen appears to have misunderstood the intent of his original correspondence, which was not to document evidence but rather to assert two generalities: 1) Adverse effects of acid deposition on ecosystems are commonly overstated. 2) The biogeochemistry of ecosystems is easily oversimplified, and natural sources of acidity are often ignored.

5003 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 40609, 40610, 40623, 40939, 41826, 41888, 41975, 41981, 41983

41928 **(DOE/ER—0332) Health and environmental consequences of the Chernobyl nuclear power plant accident.** Goldman, M.; Catlin, R.J.; Anspaugh, L. (Committee on the Assessment of Health Consequences in Exposed Populations, Washington, DC (USA). Interlaboratory Task Group on Health and Environmental Aspects of the Soviet Nuclear Accident). Jun 1987. 307p. NTIS, PC A14/MF A01; 1; GPO Dep. File Number DE87013578.

An assessment of the impact of the Chernobyl accident on the Northern Hemisphere is presented in this report. It relies heavily on the USSR report presented to the International Atomic Energy Agency. There are gaps in present knowledge and, in some areas, uncertainties may never be completely resolved. What is clearly apparent at this time, however, is that on a large regional scale, the estimates of collective dose have a reasonable level of confidence. The associated potential health impacts have also been projected, together with a range of estimates. A brief description of the tragic consequences to the heroic firefighting and rescue personnel is also provided, and valuable insights regarding acute exposures are developed. Much early effort was expended on estimation of the source term, especially for radiocesium and radioiodine. Several independent analyses are presented that are in reasonable agreement. Atmospheric transport of the radioactive material and its subsequent deposition provide a documented "umbrella" of the distributions that form the basic integration of this assessment. The estimates of radiological doses to selected Northern Hemisphere populations were employed in developing an integrated risk assessment of potential latent health effects using the most current models, parameters and risk coefficients. The estimates presented include lower- and upper-bound values, as well as the "best" or most realistic ranges. While many scientists believe that minuscule increases in risks to large populations are impossible to prove, it is essential that the magnitude of these possible risks be presented, if only to put an upper limit on the situation. It must be emphasized that while these are "potential" health effects, the values presented represent our best current assessment of the health and environmental detriment caused by the Chernobyl accident. 72 refs., 37 figs., 91 tabs.

41929 **(DP-MS—86-214) Evaluation of Savannah River Laboratory atmospheric dispersion models.** Addis, R.P. (Savannah River Lab., Aiken, SC (USA)). 1987. Contract AC09-76SR00001. 5p. (CONF-870601—21). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012942.

From Annual meeting of the American Nuclear Society; Dallas, TX, USA (7 Jun 1987).

The results of 14 daytime MATS, conducted in predominantly convectively unstable conditions, showed that Puff-Plume simulated the plume width well. Puff-Plume predicted a mean plume width which averaged 0.9 times that observed. However, it consistently overpredicted the centerline maximum concentration at 30 km downwind on average by 5.4 times that observed. However, it consistently overpredicted the centerline maximum concentration at 30 km downwind on average by 5.4 times that observed. Puff-Plume did not underestimate the maximum surface tracer concentration on any occasion. This strongly suggests that PFPL ade-

quately simulates dispersion in the cross wind direction, but does not adequately simulate dispersion in the vertical. As a result, consideration is being given to other methods of simulating dispersion in the vertical. The sequential Gaussian model 2DPUF predicted the centerline surface concentrations well in the mean, averaging 1.5 times that observed. Although 2DPUF underestimated the surface concentration on half the occasions, the greatest underestimate of the centerline concentration was only 60% of that observed.

41930 **(INIS-BR—660) Measurements of nuclear explosions wastes in the atmosphere of South Hemisphere with Ge(Li) detectors.** Jardim, J.O.D. (Sociedade Brasileira de Geofisica, Rio de Janeiro). 1985. 1p. (In Portuguese). (CONF-8511295—7-Summ.). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702768.

From 1. regional meeting of geophysics; Sao Jose dos Campos, Brazil (27 Nov 1985).

Published in summary form only.

41931 **(INIS-BR—661) Measurements of Po/sup 214/ in Sao Jose dos Campos and Cachoeira Paulista, Brazil, correlation with meteorologic data.** Marinho, E.V.A.; Nordemann, D.J.R. (Sociedade Brasileira de Geofisica, Rio de Janeiro). 1985. 1p. (In Portuguese). (CONF-8511295—8-Summ.). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702769.

From 1. regional meeting of geophysics; Sao Jose dos Campos, Brazil (27 Nov 1985).

Published in summary form only.

41932 **(INIS-XN—59) International intercalibration and intercomparison programme for radon, thoron and daughters measuring equipment. Part. 1: Radon measurement.** Knutson, E.O.; Miles, J.C.H.; Solomon, S.B. (Nuclear Energy Agency, 75 - Paris (France)). 1986. 62p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87702600.

The International Intercalibration and Intercomparison Programme for Radon, Thoron and Daughters Monitoring Equipment, abbreviated IIIP, is a program organized jointly by Nuclear Energy Agency of the Organization for Economic Cooperation and Development and the Radiation Protection Research Programme of the Commission of European Communities. The broad purpose of the IIIP is to determine if the somewhat diverse calibration procedures used in different countries are equivalent. The general approach was to select four regional reference laboratories and entrust them with the details of project definition and execution. The four selected laboratories are: Australian Radiation Laboratory, US DOE Environmental Measurements Laboratory, UK National Radiation Protection Board, US DOI Bureau of Mines. The Organizing Committee that selected the four laboratories remained intact and served an oversight function in all work to date.

41933 **(PB—87-188124/XAB) Testing of indoor radon reduction techniques in eastern Pennsylvania: an update. Published paper, May 1985-March 1987.** Henschel, D.B.; Scott, A.G. (American ATCON, Inc., Wilmington, DE). May 1987. 21p. NTIS, PC A02/MF A01.

The paper updates information from EPA tests of indoor radon-reduction techniques on 38 houses in the Reading Prong area of eastern Pennsylvania. All were basement houses with hollow-block or poured-concrete foundation walls. The reduction approaches tested in most houses involved active soil ventilation, including: suction on the footing drain tile system; suction under the concrete slabs, using pipes inserted through the slabs from inside the houses; and ventilation of the void network inside hollow-block foundation walls. Heat-recovery ventilators (HRVs) were tested in three houses. Current results confirm that, for the houses tested, drain tile suction appears consistently able to provide high radon reductions when a complete loop of drain tile exists, often reducing high-radon-level houses to 4 pCi/l (148 Bq/cu m) and less. Sub-slab suction (with pipes through the slab) can also provide high reductions if enough suction pipes are located properly. Placing one or more sub-slab suction pipes near each perimeter wall appears to aid in treating the major soil gas entry routes, although fewer pipes can sometimes give high reductions if conditions are favorable. Ventilation of block wall voids can be effective if major wall openings can be adequately closed, and if there are no major slab-related entry routes remote from the walls.

41934 **(PB—87-191540/XAB) Practical problems reducing radon in houses.** Osborne, M.C.; Brennan, T. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). May 1987. 11p. (EPA—600/D-87/161). NTIS, PC A02/MF A01.

The paper discusses practical problems encountered during efforts to reduce radon concentrations in houses. The 10 problems identified represent only a few of the many daily problems encountered by diagnosticians and mitigators. Nonetheless, they are some of the current common problems that need to be considered and hopefully resolved in the near future. The 10 problems are: inconsistent subslab aggregate, hidden pathways to chimneys, variations in porosity of concrete/cinder block and block coatings, access to radon-entry surfaces, diurnal/seasonal variation in radon concentrations, impact of radon-in-water on radon-in-air, sealing the top row of concrete blocks, insulating half-basements, sealing large thermal by-passes, and coping with direct rock exposure.

41935 **(PB—87-191557/XAB) Monitoring radon reduction in clinton, new jersey houses.** Osborne, M.C.; Brennan, T.; Michaels, L.D. (Research Triangle Inst., Research Triangle Park, NC (USA)). May 1987. 15p. NTIS, PC A02/MF A01.

The paper discusses EPA experience in monitoring radon reduction in Clinton, NJ, houses. Both the temperature-driven stack effect and typical household appliances (e.g., furnaces, whole-house fans, clothes dryers, and bathroom fans) were observed to reduce indoor pressure and potentially increase radon levels. Radon measurements obtained during cold weather, after residential heating systems were back in full operation, showed that the radon-reduction techniques that were applied had been effective and that radon concentrations were significantly reduced. Although both grab-sample and continuous-monitor measurements were helpful in assessing radon-entry sites and hour-to-hour fluctuations, respectively, only charcoal canister data collected under near-winter conditions could be used as a valid comparison with earlier March/April 1986 generated pre-radon reduction data.

41936 **(PB—87-191847/XAB) Radon mitigation in 10 clinton, New Jersey houses: a case history.** Osborne, M.C.; Brennan, T.; Michaels, L.D. (Research Triangle Inst., Research Triangle Park, NC (USA)). May 1987. 16p. NTIS, PC A02/MF A01.

The paper discusses an EPA radon mitigation demonstration project in Clinton, NJ, which included testing radon-reduction techniques in 10 houses. The 10 houses were selected from a group of 56 volunteers in the Clinton Knolls subdivision. Each of the 10 selected houses received an intensive radon diagnostic evaluation before a house-specific radon-reduction plan was developed. Before and after the plans were implemented, radon concentrations were determined by charcoal canisters and continuous radon monitors. A variety of sealing and sub-slab depressurization techniques were applied to the 10 houses. Radon concentrations were reduced by over 95% in all 10 houses. Three-month alpha-track radon measurements will continue in the radon-reduction demonstration houses for the next 2 years.

41937 **(SCPRI-RM—8-1986) Monthly results of measurements, August 1986.** (Service Central de Protection contre les Rayonnements Ionisants, 78 - Le Vesinet (France)). Sep 1986. 70p. (In French). NTIS (US Sales Only), PC A04/MF A01. File Number DE87752249.

This report of the SCPRI exposes an interpretation of the principal results concerning the routine monitoring of environmental radioactivity in France: atmospheric dusts, rainwater, surface water, underground water, sewage water, drinking water, food chain (milk, vegetables, fishes) seawater around nuclear plant sites and other sites. The activities of various radioisotopes are presented in tables. This report exposes also the results of special radiation measurements resulting from the Chernobyl accident.

41938 (SCPRI-RM—9-1986) Monthly results of measurements, September 1986, with supplement related to the three months, July, August, September 1986. (Service Central de Protection contre les Rayonnements Ionisants, 78 - Le Vesinet (France)). Oct 1986. 82p. (In French). NTIS (US Sales Only), PC A05/MF A01. File Number DE87752250.

This report of the SCPRI exposes an interpretation of the principal results concerning the routine monitoring of environmental radioactivity in France: atmospheric dusts, rainwater, surface water, underground water, sewage water, drinking water, food chain (milk, vegetables, fishes) seawater around nuclear plant sites and other sites. The activities of various radioisotopes are presented in tables. This report exposes also the results of special radiation measurements resulting from the Chernobyl accident and complementary results related to the three months July, August, September 1986.

41939 (WAPD-RC/E(HE)—2756) Effluent and environmental monitoring report for calendar year 1986. (Bettis Atomic Power Lab., West Mifflin, PA (USA)). 1986. Contract AC11-76PN00014. 56p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87011277.

The results of the radiological and non-radiological environmental monitoring programs for 1986 at the Bettis Laboratory are presented. The results obtained from the monitoring programs demonstrate that the existing procedures ensure that all environmental releases during 1986 were in accordance with applicable state and federal regulations. Evaluation of the environmental data indicates that operation of the Laboratory continued to have no adverse effect on the quality of the environment. Furthermore, a conservative assessment of radiation exposure to the general public as a result of Laboratory operations demonstrated that the dose received by any member of the public was well below the most restrictive dose limits prescribed by the Environmental Protection Agency and the Department of Energy.

41940 TRICYCLE: a new mathematical model for tritium at the global scale. Killough, G.G.; Kocher, D.C. (Oak Ridge National Lab., TN). *Journal of the Tennessee Academy of Science;* **62**: No. 2, 36-37(Apr 1987). Contract AC05-84OR21400.

TRICYCLE (for TRItium CYCLE) is a new linear dynamic compartment model that has been successful in reproducing environmental time-series data that show levels of tritium from nuclear weapons testing. Based on the global hydrologic cycle and other geophysical data, TRICYCLE includes (1) separate stratosphere compartments for the northern and southern hemispheres, (2) disaggregation of the troposphere and ocean surface waters into eight latitude zones each, (3) consideration of the different concentrations of tritium in atmospheric water vapor over land and over the ocean (the concentration over land exceeds that over the ocean by a factor of 3-4), and (4) a box-diffusion model for vertical transport in the ocean. The authors have used the model to simulate tritium in precipitation, ocean surface waters, and surface fresh waters (rivers and lakes). When they assume that 50% of the tritium from atmospheric weapons testing was injected directly into the northern stratosphere, the model gives good representations of tritium in the ocean surface waters and the rivers and lakes of the northern hemisphere; moreover, it estimates reasonable approximations to time-series measurements of tritium in marine precipitation taken at specific latitudes; and over the full range of latitudes, its representation of the high-to-low latitude gradient of tritium in marine precipitation is remarkable. Apart from their intrinsic geophysical interest, such models are useful in assessing the collective radiation dose to populations from tritium that is released at a particular latitude.

5004 Thermal Effluents Monitoring And Transport

41941 (SFB—210/E-19) Wind tunnel experiments on cooling tower plumes. Pt. 2. In non-uniform cross flow of boundary layer type. Andreopoulos, J. (Karlsruhe Univ. (T.H.) (Germany, F.R.). Sonderforschungsbereich 210 Stroemungsmechanische Bemessungsgrundlagen fuer Bauwerke). Jan 1986. 61p. NTIS, PC E09; Available from NTIS as TIB/B87-09405.

The basic characteristics of plumes issuing into a boundary layer type of cross flow are reported. The flow can be considered as an interaction between two vorticity fields with different length scales and turbulence intensities. The large eddies of the oncoming boundary layer are responsible for the observed sudden changes in the plume direction. The type of structures emanating the tower depends on the instantaneous velocity ratio. Mean velocities and normal velocity gradients are smaller than in the case of uniform cross-flow (Andreopoulos, 1986) and therefore the measured turbulence intensities were lower too. The cross-stream turbulence brings high momentum fluid into the wake region and the velocity defect decays very rapidly. Dilution of the plumes takes place faster in the presence of external turbulence than in the case with uniform cross-flow. The spreading rate is increased dramatically by the external turbulence which causes different effects on the hydrodynamic and thermal fields.

5006 Regulations

REFER ALSO TO CITATION(S) 41094

41942 (CONF-8510453—) New legislation on air pollution abatement. (Institut fuer Gewerbliche Wasserwirtschaft und Luftreinhaltung e.V. (IWL), Koeln (Germany, F.R.)). 1986. 114p. (In German). NTIS (US Sales Only), PC A06. File Number DE87770190.

From IWL conference on the new legislation on air pollution abatement; Koeln, F.R. Germany (9 Oct 1985).

The conference held on October 9th, 1985, presented 6 topical lectures analysing the new air pollution abatement regulations from the viewpoint of the legislating body, the implementing administration, the industry, the individual operator concerned, a measuring institute, and in the light of economic policy on the whole. What gave rise to and determined the points of attack of the recent amendment to the Federal Law on Immission Protection were shortcomings in its implementation, the dying forest, and the need for tools to deal with environmental protection at the economic level. The representative of industry deals particularly with the retrofitting of older plants, plants that are subject to licensing, subsequent injunctions, the amendment to the ordinance on clean air, compensations, residual materials and off-heat, while the operator concerned - an operator of steel works and blast furnaces - and the representative of economic policy point out particularly the indirect and direct economic repercussions. (HSCH).

41943 (NP—7770221) Development of criteria for TA Luft (Clean Air Technical Guide) Nr. 2.2.1.3 (check in special cases within licensing procedures) - air pollutants for which ambient air standards are not given. Brieda, F.; Kropp, L.; Priebe, A. (Technischer Ueberwachungs-Verien Rheinland e.V., Koeln (Germany, F.R.). Inst. fuer Energietechnik und Umweltschutz; Umweltbundesamt, Berlin (Germany, F.R.)). Dec 1985. 52p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE87770221.

This investigation outlines those substance which are relevant due to their occurence in German emissions inventories. Taking into account effects criteria as occupational health standards, ambient air standards, odour threshold values and standards for soil contaminants relevance lists were derived. With 19 refs., 7 tabs., 7 figs.

41944 (NP—7770222) New developments in American clean-air policy. Endres, A. (Technische Univ. Berlin (Germany, F.R.). Wirtschaftswissenschaftliche Dokumentation). 1986. 20p. (In German). NTIS (US Sales Only), PC A02. File Number DE87770222.

American clean-air policy is of outstanding interest because it was first to introduce the basic elements of the tool of 'emission certificates' into the traditional set of regulations. The certificate-based policy lays down the quantity of emissions compatible with the targets of regional environmental-protection policy; this is distributed in the form of emission rights to polluters. Such rights are transferable from one emission source to another. The brochure deals with the economic incentives, controlled emissions trading (ET), its distribution and distribution obstacles, ravision and future

of ET. As a result, ET is seen to be an important environment-political variant from the borderline area between economy and ecology. The further development after the coming into force of the Final Policy Statement will be pursued in the Western hemisphere with great interest. (orig./HSCH).

51 ENVIRONMENTAL SCIENCES, TERRESTRIAL

REFER ALSO TO CITATION(S) 41627

5101 Basic Studies

41945 (CONF-8510250—, pp 86-110) **Meterological data needs in forest science and management.** Harrington, J.B. (Canadian Forestry Service, Chalk River, Ontario). May 1987. NTIS, PC A 11. File Number DE87009894.

From Department of Energy (DOE) meterology workshop; Lake Placid, NY, USA (1 Oct 1985).

The effects of weather on growth and yield must be determined if the effects of silvicultural treatments are to be adequately explained. Better relations are needed between growth rates and environmental variables. The question of an adequate data base is addressed in this study and the status of current observing networks is discussed. Attention is focused on meteorological data needs of forestry in general.

41946 (CONF-8705160—1) **The management of VA [vesicular-arbuscular] mycorrhizae in semi-arid environments.** Miller, R.M. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 4p. NTIS, PC A02. File Number DE87011451.

From 7. North American conference on mycorrhizae; Gainesville, FL, USA (3 May 1987).

The need for management of vesicular-arbuscular mycorrhizae in semi-arid ecosystems represent an important challenge to belowground researchers especially as we increase our utilization of these stressed habitats. Within the laser couple of years several reviews have been prepared on the effects of disturbance to shrub and grasslands and their mycorrhizae. The purpose of this presentation is to discuss some research findings and management needs using examples from a high elevation cold desert, and from research in mid-grass and tallgrass prairies.

41947 (DOE/EV/02270—15) **Mass and energy budgets of animals: Behavioral and ecological implications: Progress report for period December 1, 1986-July 1987.** Porter, W.P. (Wisconsin Univ., Madison (USA)). Aug 1987. Contract AC02-76EV02270. 34p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87012751.

The vacuum gas-analysis system is running and we use doubly labeled water routinely in our research. We have the computer-controlled respirometer system running, and can routinely measure respiratory gases and body temperatures in small, living mammals. Our heat- and mass-balance model calculations of field metabolism and water loss agree exceptionally well with doubly labeled water measurements of the field metabolism and water loss for Sceloporus undulatus in the sandhill country of western Nebraska. We established theoretical links between our biophysical models of individual animals and population dynamics and community models in the literature. Our general, dry, porous-media model works for bird feathers as well as fur. Now heat and mass fluxes for any endotherm in any physical environment can be calculated with accuracy knowing only allometry, insulation properties, core or skin temperature and environmental conditions. We developed a general respiratory water-loss model using a coupled molar and heat balance. We developed a general counter-current heat exchange model with a peripheral heat generation and iterative skin temperature solution. We are testing our endotherm model on four species of temperate and tropical birds. We are completing parameter measurements for a test of the ectotherm model on an herbivorous lizard, like the test described above for the carnivorous lizard, Sceloporus undulatus. We have begun lab and field studies of the energetic costs of parasitism and climate on a small endotherm (using tapeworm infection of white-footed mice, Peromyscus leucopus). 8 figs.

41948 (GSF—39/86) **Documentation on projects to investigate forest damage currently in progress and funded by Bavarian ministries. October 1986.** (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Projektgruppe Bayern zur Erforschung der Wirkung von Umweltschadstoffen (PBWU)). Oct 1986. 84p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE87770224.

This project documentation was prepared for the coordination of research in forest damage in the area of the Land Bavaria. The listings including a brief project description each and, where applicable, some hints at field investigation sites as well as the registers attached, are to enable interested readers to obtain an overview on the current state of research activities on the part of Bavarian sponsors.

41949 (INIS-BR—659) **Results of trace register technique application in the radonium detection for uranium prospection in soils, in Caetite (BA), Brazil.** Morais, M.A.P.V. de; Cesar, M.F. (Sociedade Brasileira de Geofisica, Rio de Janeiro). 1985. 1p. (In Portuguese). (CONF-8511295—6-Summ.). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702767.

From 1. regional meeting of geophysics; Sao Jose dos Campos, Brazil (27 Nov 1985).

Published in summary form only.

41950 (NP—7770229) **Modification of element fluxes, particularly with reference to heavy metal mobility, by the influence of acid rain in the water unsaturated zone of a podsol site.** Gruhn, A. (Kiel Univ. (Germany, F.R.). Geologisch-Palaeontologisches Inst. und Museum; Kiel Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet). Jun 1986. 178p. (In German). NTIS (US Sales Only), PC A09/MF A01. File Number DE87770229.

Bench-scale experiments on the influence of model precipitation-waters of different characteristics were carried through using undisturbed monolith lysimeters from a podsol site. The model precipitation-waters chosen were a water sample adapted to the natural chemism of precipitations in the sampling area, an 'acid' rainwater, and two water samples of varied pH-value and with additives of heavy metals. The basic trends of the mass balances mostly remained unaltered by the increased transport rates from acid precipitation and heavy-metal-containing precipitation; the element quantities mobilized additionally were mostly also released in those horizons where element mobilization ensued under 'normal' conditions. With 35 figs., 29 tabs.

41951 **Swanflow finite element model for water, air, and nonaqueous phase flow.** Bledsoe, J.L.; Fields, D.E. (Oak Ridge National Lab., TN). *Journal of the Tennessee Academy of Science;* **62**: No. 2, 38(Apr 1987).

Swanflow (Simultaneous Water Air and Nonaqueous Phase FLOW) is a two-dimensional finite-difference code which simulates the flow of water and an immiscible nonaqueous phase liquid (NAPL) within and below the vadose zone, that region in the earth above permanent groundwater level. The model is based on a modified formulation of conventional three-phase flow equations used in the petroleum industry for evaluation of black oil reservoirs. This model has possible application in such areas as the study of hazardous waste, groundwater restoration, and fuel spills and leaks.

41952 **Initial investigation of a carbonaceous component of the K/T boundary clay.** Crenshaw, J.M.; Fields, D.E. (Oak Ridge National Lab., TN). *Journal of the Tennessee Academy of Science;* **62**: No. 2, 37(Apr 1987). Contract AC05-84OR21400.

Samples of clay from the K/T boundary layer have been obtained, and a carbonaceous fraction has been extracted. This component has been examined using electron microscopy, LASER-flow cytometry, RAMAN spectroscopy, and X-ray diffraction. The par-

ticle size distribution and morphologies have been determined. The physical and optical properties of these particles are being studied to determine residence times and assess past possible climatic effects.

5102 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 40416, 41886, 41888, 41939, 41973, 41974, 42254, 42285, 42286

41953 **(AD-A—180488/9/XAB) Installation Restoration Program. Phase 2. Confirmation/quantification, Stage 1. Final report, April 1984-March 1985.** (Dames and Moore, Park Ridge, IL (USA)). 6 Mar 1987. 195p. NTISMF A01.

Availability: Microfiche copies only.

As part of the USAF Installation Restoration Program (IRP), seven sites on Holloman Air Force Base, New Mexico, were investigated to determine the presence of hazardous-material contamination resulting from past handling and disposal practices. The seven sites investigated were the existing main-base landfill, Building 301-Aircraft Maintenance Hangar, the old AGE refueling station, a sodium arsenite spill site, a chromic-acid spill site, a collapsed sewer line from the primate research area, and the fire department training area. Field investigations consisted of installation and logging of monitor wells and soil borings. Ground water and soil samples were subject to chemical analysis for heavy metals , TOC, TOX, oil and grease, phenolics, pesticides, and tritium and carbon-14. Contamination is indicated at the main-base landfill, Building 301, and the old AGE refueling station. Additional sampling and analyses are recommended to define the nature, extent, and potential for migration of contaminants at those sites.

41954 (CONF-8510250—, pp 32-57) **Remote sensing in forest science.** Williams, D.L. (NASA/Goddard Space Flight Center, Greenbelt, MD). May 1987. NTIS, PC A 11. File Number DE87009894.

From Department of Energy (DOE) meterology workshop; Lake Placid, NY, USA (1 Oct 1985).

Advances in the state-of-the-art of remote sensing over the last couple of decades have led to the development of systems and techniques to assess many biophysical variables of interest to both researchers and practicing foresters. The basic concepts underlying today's quantitative remote sensing technology are reviewed, and the results of several investigations dealing with the remote assessment of various forest (stress) conditions are summarized. Of particular interest is the fact that two independent studies yielded results indicating that three of the four most useful wavebands for discriminating forest cover types and/or variations in canopy closure were Thematic Mapper bands 1, 5, and 7 - bands covering wavelength regions not formerly available on earth-orbiting satellites. The paper concludes with the presentation of preliminary results obtained in an on-going effort to explore the role of quantitative remote sensing relative to assessing suspected acid rain-induced damage in high-elevation spruce/fir forests. The most significant result has been the detection of an approximate 10 nanometer shift toward shorter wavelengths in the chlorophyll b absorption region for both branch samples and in situ forest canopy spectra collected from high damage sites in comparison to spectra from moderate to low damage sites. Similar spectral shifts have been previously documented in geobotanical studies, and high concentrations of heavy metals in the underlying soil were implicated as the causal agent. 21 references, 4 figures, 1 table.

41955 (CONF-8510250—, pp 111-146) **Chemical interactions of a forest canopy with the atmosphere.** Reiners, W.A.; Lovett, G.M.; Olson, R.K. (Univ. of Wyoming, Laramie). May 1987. NTIS, PC A 11. File Number DE87009894.

From Department of Energy (DOE) meterology workshop; Lake Placid, NY, USA (1 Oct 1985).

This paper reviews a progressive series of investigations on chemical interactions between the atmosphere and canopies of subalpine balsam fir forests. These forests are found just below treeline in the Adirondack, Green, and White Mountains of northeastern US. Besides being subject to considerable loading of heavy metals, NH_4^+, NO_3^-, SO_4/sup =/ and H^+ ions through cloud droplet deposition as well as incident precipitation, this forest type is a good model for research because of its simplicity and small stature. 22 references, 7 figures, 1 table.

41956 (CONF-8510250—, pp 148-181) **Gas exchange between forest and atmosphere.** Murphy, C.E. Jr. (Savannah River Lab., Aiken, SC). May 1987. NTIS, PC A 11. File Number DE87009894.

From Department of Energy (DOE) meterology workshop; Lake Placid, NY, USA (1 Oct 1985).

The subject of gas exchange between the atmosphere and forests has been of interest to plant scientists for many years because of the crucial role exchange of water and carbon dioxide plays in the survival, growth and competition between plants. More recently, attention has been directed to gas exchange has increased because of interest in uptake of pollutants by forest vegetation. In this paper forest gas exchange will be discussed in terms of the processes which control the rate of exchange with the atmosphere. Examples will be presented to show how vegetative uptake is controlled in gases with different characteristics. The prediction of uptake for large areas and over long periods of time is discussed in terms of quantitative models of the gas exchange processes. Finally, remote sensing suggested as a means of obtaining the parameters needed to make model predictions. 48 references, 6 figures.

41957 (CONF-8510250—, pp 222-236) **Forest soils and acid deposition - an overview and synthesis.** Binkley, D. (Duke Univ., Durham, NC). May 1987. NTIS, PC A 11. File Number DE87009894.

From Department of Energy (DOE) meterology workshop; Lake Placid, NY, USA (1 Oct 1985).

Soil acidification can be driven by both deposition of chemicals from the atmosphere and internal-ecosystem processes. The potential effects of acid deposition can be evaluated in an ecosystem context through the use of H+ budgets. Soil acidity is comprised of H+ free in soil solution, exchangeable pools of H+ and A13+, and titratable pools of H+ that can be removed only by strong bases. Major processes that add H+ to ecosystems include: dissociation of carbonic acid production and dissociation of organic acids, uptake of nutrient cations by plants and microbes, production of nitric acid from oxidation of ammonia coupled with nitrate leaching from the soil, and atmospheric deposition. Major H+ consuming processes include: adsorption on cation exchange sites, protonation of organic acids, release of nutrient cations from organic matter through decomposition or fire, specific adsorption of anions, and weathering of soil minerals. Soils that are most sensitive to acidification are often characterized as young, shallow, coarse-textured, and lacking in carbonates and other readily weatherable minerals. Much research is needed to improve their understanding of H+ budgets and ecosystem acidification, but definitive verifications of the impacts of acid deposition will probably be obtained only in severely damaged ecosystems. Policy makers need to view the risks from a epidemiological viewpoint rather hope for conclusive scientific experimentation. 20 references, 6 figures, 1 table.

41958 **(DPST—85-689) Metallurgical Laboratory Basin: Environmental information document.** Johnson, W.F.; Michael, L.M. (Savannah River Lab., Aiken, SC (USA)). Dec 1986. Contract AC09-76SR00001. 141p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87013036.

The Metallurgical Laboratory Basin, located in A Area at the Savannah River Plant (SRP), has received wastewater effluent from Building 723-A since 1956. Liquid effluents released to the basin have consisted of small quantities of laboratory wastes from metallographic sample preparation (degreasing, cleaning, etching) and corrosion testing of stainless steels and nickel-based alloys. All discharges to the basin were stopped on November 8, 1985. A program to characterize the chemical makeup of the sediments directly beneath and in the vicinity of the basin as well as to establish the quality of the basin water and local groundwater has been completed. Extraction Procedure (EP) toxicity tests for metals were performed on soil samples taken from beneath and around the basin and along the process sewer pipeline. Results indicate that all tested parameters were found to be at values less than respective Environmental Protection Agency (EPA) hazardous waste guidelines. Analyses of water samples collected from the basin indicate that all primary drinking water standards were met. The closure options

considered for the Metallurgical Laboratory Basin are waste removal and closure, no waste removal and closure, and no action. The predominant pathways for human exposure to chemical contaminants are through subsurface and atmospheric transport. Modeling calculations were made to determine the risk to human population via these two general pathways for the three postulated closure options for the basin. Cost estimates for each of the closure options at the basin have been prepared.

41959 **(DPST—85-698) New TNX Seepage Basin: Environmental information document.** Dunaway, J.K.W.; Johnson, W.F.; Kingley, L.E.; Simmons, R.V.; Bledsoe, H.W. (Savannah River Lab., Aiken, SC (USA)). Dec 1986. Contract AC09-76SR00001. 173p. NTIS, PC A08. File Number DE87013040.

The New TNX Seepage Basin has been in operation at the Savannah River Plant (SRP) since 1980 and is located in the southeastern section of the TNX facility. The basin receives waste from pilot scale tests conducted at TNX in support of the Defense Waste Processing Facility (DWPF) and the plant Separations area. The basin is scheduled for closure after the TNX Effluent Treatment Plant (ETP) begins operation. The basin will be closed pursuant to all applicable state and federal regulations. A statistical analysis of monitoring data indicates elevated levels of sodium and zinc in the groundwater at this site. Closure options considered for the New TNX Seepage Basin include waste removal and closure, no waste removal and closure, and no action. The two predominant pathways for human exposure to chemical contaminants are through surface, subsurface, and atmospheric transport. Modeling calculations were made to determine the risks to human population via these general pathways for the three postulated closure options for the New TNX Seepage Basin. Cost estimates for each closure option at the basin have also been prepared. An evaluation of the environmental impacts from the New TNX Seepage Basin indicate that the relative risks to human health and ecosystems for the postulated closure options are low. The transport of six chemical and one radionuclide constituents through the environmental pathways from the basin were modeled. The maximum chemical carcinogenic risk and the noncarcinogenic risk for the groundwater pathways were from exposure to trichloromethane and nitrate.

41960 **(DPST—85-713) Gun Site 720 Rubble Pit: Environmental information document.** Huber, L.A.; Bledsoe, H.W. (Savannah River Lab., Aiken, SC (USA)). Dec 1986. Contract AC09-76SR00001. 41p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013037.

The Gun Site 720 Rubble Pit is located north of D Area at the Savannah River Plant (SRP). This rubble pit is near the location of a former gun replacement in operation during the mid-1950s. Eight drums (from visual inspection) of unknown content and origin were disposed at this waste site. No soil cores from the rubble pit have been collected and analyzed. Groundwater in the area has not been evaluated because there are no monitoring wells in the vicinity. The closure options postulated for the site are waste removal and closure, no waste removal and closure, and no action. No human health risk calculations were performed for this site because no materials disposed at the site could be identified as presenting a health or environmental risk. A cost estimate for each closure option was prepared. The cost analysis shows that removal of the drums and surface soils from the Gun Site 720 Rubble Pit and disposal in a waste storage/disposal facility is more expensive than the other two options by about a factor of 2.

41961 **(KFK-PEF—11) Study for and demonstration of a modular inventory and monitoring system for actual damages in European forests.** Hildebrandt, G.; Grundmann, O.; Schmidtke, H.; Tepasse, P. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftre). Dec 1986. 87p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE87770231.

Forest decline inventory on large areas using CIR-photos has been prooved as a system with many advantages against pure terrestrial inventories. The use of a well-defined catalogue of basic parameters and the application of an uniform classification method ensures the comparability of inventories in different countries at different times. The modular structure allows to adapt the inventory system to different requirements and conditions. With 22 figs., 27 refs.

41962 **(NP—7770185) Effects of different landscape patterns on the heavy metal concentration in soils and on the heavy metal deposition in surface water. Final report.** Ditter, P.; Goettlicher-Goebel, U.; Janke, E.; Tarrach, C.; Wohlrab, B. (Giessen Univ. (Germany, F.R.). Inst. fuer Mikrobiologie und Landeskultur). Feb 1984. 40p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE87770185.

A region of new red sandstone and a mountain region were selected as areas of investigation. The effects of soil type and land use on the heavy metal concentrations in soils, sediments, and flowing water were investigated. The heavy metal burden from precipitations and emissions is determined.

41963 **(PB—87-191383/XAB) Background document on proposed liner and leak-detection rule.** Bonaparte, R.; Giroud, J.P.; Wallace, R.B.; Ah-Line, C.; Prillman, J. (NUS Corp., Rockville, MD (USA)). May 1987. 535p. NTIS, PC A23/MF A01.

The document presents a state-of-the-art review of available technologies and achievable performance levels in leak-detection systems at hazardous-waste-management units. The review is necessary to establish the best demonstrated available technology (BDAT) for leak-detection systems. It provides the critical information considered in developing EPA's regulatory options and describes the criteria used to select among the options. The document also presents a rationale and technical data to support extension of the double-liner system requirements to waste piles, significant unused portions, and certain other units. Lastly, the document presents a comprehensive discussion of the issues, methodologies, and benefits associated with construction quality-assurance programs at hazardous-waste-management facilities.

41964 **(PB—87-193421/XAB) Hazardous waste in selected Florida counties, Study Area Data: generator data and characteristics of sanitary landfills, first interim report.** Herndon, R.C.; Moerlins, J.E. (Florida State Univ., Tallahassee (USA)). May 1987. 787p. NTIS, PC A99/MF E04.

See also PB—87-193439.

The purpose of this report is to provide data to the U.S. EPA on the use of sanitary landfills for hazardous-waste disposal in Florida by small-quantity generators. The report was completed in two stages, each resulting in a three-volume interim report. The first interim report contains data on 22 additional counties. Each interim report consists of one volume called Study Area Data, where the data are aggregated across all counties included in that report. The hazardous-waste data are cross tabulated and displayed in the following seven configurations: types of wastes generated (26 types); management methods used (14 methods); types of wastes disposed in sanitary landfills; SIC generating waste; types of wastes generated by SIC; management methods used by SIC; and waste types by SIC by management method.

41965 **(PB—87-193439/XAB) Hazardous waste in selected Florida counties, County Data: generator data and characteristics of sanitary landfills, first interim report. Volume 1.** Herndon, R.C.; Moerlins, J.E. (Florida State Univ., Tallahassee (USA)). May 1987. 914p. NTIS, PC A99/MF E04.

See also PB—87-193421 and PB—87-193447.

The purpose of this report is to provide data to the U.S. EPA on the use of sanitary landfills for hazardous-waste disposal in Florida by small-quantity generators. The report was completed in two stages, each resulting in a three-volume interim report. The first interim report contains data on 22 additional counties. Information is provided on all permitted sanitary landfills that are currently active in the county. There are 67 counties in Florida, and the 43 included in the report represent more than 90% of total state population and manufacturing activity. The report contains survey data from approximately 12,000 hazardous-waste generators that reside in 488 industries. The hazardous waste data are cross tabulated and displayed in the following seven configurations: types of wastes generated (26 types); management methods used (14 methods);

types of wastes disposed in sanitary landfills; SIC generating waste; types of wastes generated by SIC; management methods used by SIC; and waste types by SIC by management method.

41966 **(PB—87-193447/XAB) Hazardous waste in selected Florida counties, County Data: generator data and characteristics of sanitary landfills, first interim report. Volume 2.** Herndon, R.C.; Moerlins, J.E. (Florida State Univ., Tallahassee (USA)). May 1987. 1061p. NTIS, PC A99/MF E06.

See also PB—87-193439 and PB—87-193454.

The purpose of this report is to provide data to the U.S. EPA on the use of sanitary landfills for hazardous-waste disposal in Florida by small-quantity generators. The report was completed in two stages, each resulting in a three-volume interim report. The first interim report contains data on 22 additional counties. Information is provided on all permitted sanitary landfills that are currently active in the county. There are 67 counties in Florida, and the 43 included in the report represent more than 90% of total state population and manufacturing activity. The hazardous-waste data are cross tabulated and displayed in the following seven configurations: types of wastes generated (26 types); management methods used (14 methods); types of wastes disposed in sanitary landfills; SIC generating waste; types of wastes generated by SIC; management methods used by SIC; and waste types by SIC by management method.

41967 **(PB—87-193454/XAB) Hazardous waste in selected Florida counties, Study Area Data: generator data and characteristics of sanitary landfills, second interim report.** Herndon, R.C.; Moerlins, J.E. (Florida State Univ., Tallahassee (USA)). May 1987. 1149p. NTIS, PC A99/MF E06.

See also PB—87-193447 and PB—87-193462.

The purpose of this report is to provide data to the U.S. EPA on the use of sanitary landfills for hazardous-waste disposal in Florida by small-quantity generators. The report was completed in two stages, each resulting in a three-volume interim report. Each interim report consists of one volume called Study Area Data, where the data are aggregated across all counties included in that report. The other two volumes of each interim report contain data at the individual county level. Information is provided on all permitted sanitary landfills that are currently active in the county. The hazardous-waste data are cross tabulated and displayed in the following seven configurations: types of wastes generated (26 types); management methods used (14 methods); types of wastes disposed in sanitary landfills; SIC generating waste; types of wastes generated by SIC; management methods used by SIC; and waste types by SIC by management method. The last cross tabulation consists of 14 sub-cross tabulations, one for each management method.

41968 **(PB—87-193462/XAB) Hazardous waste in selected Florida counties, County Data: generator data and characteristics of sanitary landfills, second interim report. Volume 1.** Herndon, R.C.; Moerlins, J.E. (Florida State Univ., Tallahassee (USA)). May 1987. 1081p. NTIS, PC A99/MF E06.

See also PB—87-193454 and PB—87-193470.

The purpose of this report is to provide data to the U.S. EPA on the use of sanitary landfills for hazardous-waste disposal in Florida by small-quantity generators. The report was completed in two stages, each resulting in a three-volume interim report. Each interim report consists of one volume called Study Area Data, where the data are aggregated across all counties included in that report. Information is provided on all permitted sanitary landfills that are currently active in the county. The hazardous-waste data are cross tabulated and displayed in the following seven configurations: types of wastes generated (26 types); management methods used (14 methods); types of wastes disposed in sanitary landfills; SIC generating wastes; types of wastes generated by SIC; management methods used by SIC; and waste types by SIC by management method.

41969 **(PB—87-193470/XAB) Hazardous waste in selected Florida counties, County Data: generator data and characteristics of sanitary landfills, second interim report. Volume 2.** Herndon, R.C.; Moerlins, J.E. (Florida State Univ., Tallahassee (USA)). May 1987. 1284p. NTIS, PC A99/MF E08.

See also PB—87-193462.

The purpose of this report is to provide data to the U.S. EPA on the use of sanitary landfills for hazardous-waste disposal in Florida by small-quantity generators. Each interim report consists of one volume called Study Area Data, where the data are aggregated across all counties included in that report. The hazardous-waste data are cross tabulated and displayed in the following seven configurations: types of wastes generated (26 types); management methods used (14 methods); types of wastes disposed in sanitary landfills; SIC generating waste; types of wastes generated by SIC; management methods used by SIC; and waste types by SIC by management method. The last cross tabulation consists of 14 sub-cross tabulations, one for each management method.

41970 **(PNL-SA—14843) In situ vitrification: An innovative thermal treatment technology.** Fitzpatrick, V.F.; Timmerman, C.L.; Buelt, J.L. (Pacific Northwest Lab., Richland, WA (USA)). Mar 1987. Contract AC06-76RL01830. 18p. (CONF-870695—8). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012169.

From 80. annual meeting of the Air Pollution Control Association; New York, NY, USA (1 Jun 1987).

In situ vitrification is a thermal treatment process that converts contaminated soil into a chemically inert, stable glass and crystalline product. A square array of four electrodes are inserted into the ground to the desired treatment depth. Because the soil is not electrically conductive once the moisture has been driven off, a conductive mixture of flaked graphite and glass frit is placed among the electrodes to act as the starter path. An electrical potential is applied to the electrodes, which establishes an electrical current in the starter path. The resultant power heats the starter path and surrounding soil up to 3600°F, well above the initial melting temperature or fusion temperature of soils. The normal fusion temperature of soil ranges between 2000 and 2500°F. The graphite starter path is eventually consumed by oxidation, and the current is transferred to the molten soil, which is now electrically conductive. As the vitrified zone grows, it incorporates nonvolatile elements and destroys organic components by pyrolysis. The pyrolyzed byproducts migrate to the surface of the vitrified zone, where they combust in the presence of oxygen. A hood placed over the processing area provides confinement for the combustion gases, and the gases are drawn into the off-gas treatment system.

5103 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 40500, 40502, 40512, 40542, 40564, 40565, 40604, 40609, 40610, 40623, 41826, 41888, 41928, 41937, 41938, 41939

41971 **(CEA-R—5367) Modelisation of the transfert of radionuclides through the food chain following a single deposition.** Maubert, H.; Quinault, J.M.; Roussel, S. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France)). Oct 1986. 63p. (In French). NTIS (US Sales Only), PC A04/MF A01. File Number DE87752248.

Many radionuclide transfer models were established for routine releases. A modelisation of the agricultural system response to an unique deposition is proposed in this work. On the basis of a literature survey of the existing models and appropriate experimentations, the behaviour of a basic cell soil migration-root uptake is described. The first results are displayed under the form of curve sets able to yield a rapid estimate of edible parts contamination. These curves were derived for a period of 100 years following the accidental deposition.

41972 **(CONF-870701—5) Plutonium contamination twenty years after the nuclear weapons accident in Spain.** Iranzo, E.; Richmond, C.R. (Oak Ridge National Lab., TN (USA); Junta de Energia Nuclear, Madrid (Spain)). 1987. Contract AC05-84OR21400. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012531.

From 8. international congress of radiation research; Edinburgh, UK (19 Jul 1987).

An accident involving two US Air Force planes engaged in a refueling operation occurred at 0922 GMT on January 17, 1966 over the town of Palomares in southeastern Spain. Three of the bombs, one intact, were found on land, in or near Palomares while the fourth was removed from the Mediterranean Sea. The para-

chutes of two of the bombs did not deploy resulting in the detonation of their conventional explosives and release of fissile material upon impact. Partial burning of the fissile material formed an aerosol that contaminated approximately 226 hectares of uncultivated, farmed, and urban land. The objective of this study was to determine the magnitude of the risk from internal contamination of the area inhabitants immediately after the accident and during the emergency phase and to determine the short, medium and long-term risk of internal contamination for the inhabitants of Palomares and its environs and to those who consume planet products cultivated in that area.

41973 **(DOE/ER—0331) Transport of contaminants in the subsurface: The role of organic and inorganic colloidal particles: Summary report.** (Oak Ridge National Lab., TN (USA); USDOE Office of Energy Research, Washington, DC. Ecological Research Div.). 1986. Contract AC05-84OR21400. 72p. (CONF-861036—Summ.; ORNL/M—349). NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87012029.

From Role of organic and inorganic colloids in subsurface transport; Manteo, NC, USA (5 Oct 1986).

Current knowledge was reviewed about the role played by colloids on the mobility of contaminants in the subsurface environment, and to identify important long-term research needs in this area. Recent findings on the occurrence and nature of colloidal material in the subsurface as well as on the association of colloids with organic, metal, and radionuclide contaminants were presented and discussed. Field studies have demonstrated that colloidal particles do move through aquifers and that radionuclides have been transported much further than predicted due to their association with mobile colloids in the groundwater. The consensus of the meeting was that colloids do occur in the subsurface environment, are capable of binding organic and inorganic contaminants, and do alter the mobility of contaminants. A major difficulty in understanding and predicting the role of colloids is their heterogenous nature that hampers precise chemical characterization. Clay and metal oxide colloids can be formed or dissolved due to changes in solution chemistry in the aquifer. Organic colloids have variable and diverse functional groups, making it difficult to predict their association with metal and radionuclide contaminants. Some important advances were reported toward understanding the assembly of organic colloids and the nature of their interactions with organic contaminants. Major research needs identified by the participants included studies in real systems on the occurrence of colloids in subsurface environments, and more rigorous characterization of the physical and chemical properties of the colloidal material. Methods for sampling colloids need to be improved to avoid production of artifacts during collection.

41974 **(DPST—86-298) Methodology and parameters for assessing human health effects for waste sites at the Savannah River Plant: Environmental information document.** King, C.M.; Marter, W.L.; Looney, B.B.; Pickett, J.B. (Savannah River Lab., Aiken, SC (USA)). Mar 1987. Contract AC09-76SR00001. 290p. NTIS, PC A13. File Number DE87013043.

This report provides a summary of the components of risk assessment and presents the technical basis for application of the risk evaluation process to the principal pollutants at SRP: radionuclides, toxic chemicals, and carcinogenic compounds. An extensive technical data base from the fields of radiation health physics, toxicology, and environmental sciences is required to accomplish this task. The origin and meaning of this data base is summarized for each class of contaminant and parameter values provided for use in numerical analysis of risk. The process of risk assessment is associated with uncertainties, a fact which is frequently stated in the technical literature addressing this subject. A review of risk assessment uncertainties and the limitations of predictive risk assessment are summarized. Risk estimators for each class of contaminants at the SRP have been tabulated for radionuclides, toxic chemicals, and carcinogens from the technical literature. Estimation of human health risk is not an additive process for radiation effects and chemical carcinogenesis since their respective dosimetric models are distinctly different even though the induction of cancer is reported to be the common end result. It is recommended in this report that risk estimation for radionuclides and chemical carcinogens should be tabulated separately and this recommendation has been applied in all environmental information documentation published by the Savannah River Laboratory. Impacts due to toxic chemicals in the biosphere should also be estimated as a separate entity since toxic chemical risk estimators are uniquely different and do not reflect the probability of a detrimental health effect. 23 refs., 4 figs., 13 tabs.

41975 **(FS—86-39-AKU) Radioactivity in the Federal Republic of Germany and in Switzerland after the Chernobyl reactor accident. Results of a measuring campaign by the Activity Group for Environmental Monitoring.** Winter, M.; Meyer, P.; Voelkle, H.; Narrog, J.; Kirchhoff, K. (Fachverband fuer Strahlenschutz e.V., Karlsruhe (Germany, F.R.); Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Hauptabteilung Sicherheit; Ministerium fuer Ernaehrung, Landwirtschaft, Umwelt und Forsten Baden-Wuerttemberg, Stuttgart (Germany, F.R.)). Oct 1986. 80p. (In German). NTIS, PC E09; Available from NTIS as TIB/B87-07745.

The variations of immissions with time, and the nuclide compositions are briefly reported. The measuring campaign carried through between April 28 and June 20, 1986, was restricted to data obtainable by direct measuring. Arithmetic means were derived and are given together with the simple standard deviation in per cent, related to given measuring areas and time periods. The data include measuring results of external radiation exposure (local dose rate, local dose, and background dose) and nuclide-specific activity data for air, depositions, grass, soil, cow milk, green leave vegetables, and other food such as meat; they are presented in tables, predominantly for the leading isotopes I-131 and Cs-137.

41976 (IAEA-SR—110, pp 55) **Criteria and evaluation of shallow land burial sites.** Chandra, U. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, Brazil). 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE87702447. (CONF-861065—Absts.).

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

41977 (IAEA-SR—110, pp 63) **Ion exchange properties of three Brazilian soils with high clay mineral and their use in radionuclide adsorption.** Miekeley, N.; Albuquerque, P.C.W. de. (Pontificia Univ. Catolica do Rio de Janeiro, Brazil. Dept. de Quimica). 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE87702447. (CONF-861065—Absts.).

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

41978 **(VROM-DSB—85-4) Natural background radiation in The Netherlands. Part 1. Field measurements.** Dongen, R. van; Potma, C.J.M.; Stoute, J.R.D. (Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer, The Hague (Netherlands). Directie Stralenbescherming). May 1985. 68p. (In Dutch). (VROM—60529/6-86). Library KNAW, P.O. Box 19121, 1000 GC Amsterdam, The Netherlands.

The level of the environmental background radiation is investigated. Therefore at about 1000 points equally partitioned over the Netherlands gamma exposure rates are determined. After corrections for cosmic radiation the values of the exposure rates are mapped out. The level of the gamma radiation originating from the earth's crust varies between 1.1 and 7.2 microRem/h. In comparing the radiation map of the Netherlands with the type of soil map it appears that large values are found in clay soils and small values in sandy soils. 15 references, 15 figures, 7 tables.

41979 (VROM-DSB—85-8) Concentration of radionuclides in building materials and soils in The Netherlands. Ackers, J.G. (Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer, The Hague (Netherlands). Directie Stralenbescherming). Nov 1985. 31p. (In Dutch). (VROM—851051/1-86). NTIS (US Sales Only), PC A03/MF A01. File Number DE87702862.

About 150 samples of building materials used in the Netherlands have been analysed by gamma spectrometry for their Ra-226, Th-232 and K-40 concentrations. From 26 samples of soils the radioactivity concentration was measured. Calibration was performed by the use of a large volume standard source made as a mixture of monazite, pitchblende and silica. The results are reported in $Bq.kg^{-1}$; the statistical error is within 5% (standard deviation) and for most of the results the systematic error is smaller than 15%. Most of the building materials and all soil samples revealed activity concentrations smaller than 100 $Bq.kg^{-1}$ for Ra-226 and Th-232 and smaller than 1000 $Bq.kg^{-1}$ for K-40. Part of the results is compared with data published elsewhere. 12 references, 15 figures, 2 tables.

41980 (VROM-DSB—85-9) Radon exhalation rates measured at surfaces of building materials and soil in The Netherlands. Ackers, J.G. (Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer, The Hague (Netherlands). Directie Stralenbescherming). Nov 1985. 22p. (In Dutch). (VROM—851052/1-86). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702863.

A method is described for the determination of the radon exhalation rate from the surface of building material or soil. The results of measurements in the Netherlands are given. Slabs with dimensions of about 0.5 x 0.5 x 0.1 m^3 were made for laboratory measurements on building materials. The results for the Rn-222 exhalation rates are an average value of 2.6 $Bq.m^{-2}.h^{-1}$ for concrete, about 1 $Bq.m^{-2}.h^{-1}$ for clay bricks, around 1.5 $Bq.m^{-2}.h^{-1}$ for blocks of natural gypsum and 6-16 $Bq.m^{-2}.h^{-1}$ for some phosphogypsum blocks. The method was also applied in situ at walls in occupied dwellings. Measurements made on some soil surfaces revealed radon exhalation rates of 0.5-2.7 $Bq.m^{-2}.h^{-1}$ per $Bq.kg^{-1}$ Ra-226 concentration of the soil. 11 references, 5 figures, 3 tables.

41981 (VROM-DSB—85-10) Radiation exposure of the population and indoor radiation levels in The Netherlands caused by natural gamma sources. Julius, H.W.; Dongen, R. van. (Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer, The Hague (Netherlands). Directie Stralenbescherming). Nov 1985. 106p. (In Dutch). (VROM—851053/1-86). NTIS (US Sales Only), PC A06/MF A01. File Number DE87702864.

An estimate has been made of gamma doses to the population in the Netherlands, caused by natural radiation sources encountered in the environment. Data are given, derived from two independent types of measurements: 1. Exposure/dose rate measurements in the living environment (private houses as well as workplaces), using a high pressure ionization chamber and thermoluminescent dosemeters (TLD) respectively and 2. Individual monitoring, using TLD. The study included some 750 individuals, 400 houses and 275 workplaces. The participants were selected and divided into two groups on the basis of their location in areas of relatively high and low terrestrial radiation level respectively. Distinction was made between three categories of individuals with respect to their patterns of life. An estimate was made of the influence of the terrestrial component of the natural background and of some typical building materials on the indoor radiation level. An average indoor exposure rate of 9.4 $\mu R.h^{-1}$ (6.7×10^{-13} C0144.s)$^{-1}$) and a dose rate of 9.3 $\mu rad.h^{-1}$ (93 $nGy.h^{-1}$) for individuals were found, both with a standard deviation of 15-20%. 23 references, 15 figures, 25 tables.

41982 (VROM-DSB—85-11) Radioecology of and radiation dose from Dutch waste gypsum released into the environment. Koster, H.W.; Weers, A.W. van. (Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer, The Hague (Netherlands). Directie Stralenbescherming). Nov 1985. 129p. (In Dutch). (VROM—851054/1-86). NTIS (US Sales Only), PC A07/MF A01. File Number DE87702865.

The Dutch industries release 9 kinds of waste gypsum, 90% of the total quantity is phosphogypsum. Only waste gypsums from the phosphate industries show increased radioactivity, the strongest in phosphogypsum. All phosphogypsum, 2 $Tg.a^{-1}$, is disposed of into the Rhine at Rotterdam. This leads to an increase of radionuclides, from the U-238 chain, along the Dutch coast. The calculated increase of activity concentrations in sea food causes an increase of the individual radiation dose of maximal 150 $\mu Sv.a^{-1}$ and of the Dutch population dose of 170 $manSv.a^{-1}$. Stacking of the phosphogypsum would result in a dose increase of one order of magnitude lower. The need for environmental disposal or stacking of at least the fine and coarse fractions of the phosphogypsum, which are difficult to recycle, will remain. 59 references, 7 figures, 37 tables.

41983 (VROM-DSB—85-12) Survey and specimen taking of building materials which are destined for house building in The Netherlands. Boer, J.F. den. (Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer, The Hague (Netherlands). Directie Stralenbescherming). Nov 1985. 112p. (In Dutch). (VROM—851055/1-85). NTIS (US Sales Only), PC A06/MF A01. File Number DE87702866.

This investigation deals with the following items: (a) Some building materials cause an increase of the natural radioactive radiation level indoors, especially building materials containing a certain kind of phosphogypsum. The radiation level depends among other things on the applied quantity of building materials and on the location in the building (walls, floors or roofs, etc.). The soil underneath dwellings can also be an important radiation source. The report gives a listing of the kind of building materials used for dwellings in The Netherlands, both present ones as well as possible future ones. A survey of the quantities applied and the location of application in dwellings is also given. The different types of soil underneath the dwellings are discussed. (b) Samples were collected from various factories, dealers and other sources (both present and future samples) of the most important building materials and components thereof. The samples were handed over to Division of Technology for Society TNO, Radiological Service TNO and Netherland Energy Research Foundation, in order to measure the activity concentrations and the radon exhalations. A listing of the samples is given. 35 references, 28 figures, 16 tables.

41984 Experiments on pollutant transport from soil into residential basements by pressure-driven airflow. Nazaroff, W.W.; Lewis, S.R.; Doyle, S.M.; Moed, B.A.; Nero, A.V. (Lawrence Berkeley Lab., CA). *Environmental Science and Technology;* **21**: No. 5, 459-466(May 1987). Contract AC03-76SF00098.

At two residences in Portland, OR, they have investigated (1) the coupling between residential basements and the air in nearby soil and (2) the influence of basement depressurization on the migration of air in soil. With the basements depressurized 25-50 Pa relative to outdoor air, underpressures as great as 20-40% of those in the basement were observed at sampling points in the soil. Sulfur hexafluoride was injected into the soil near the houses and its concentration monitored in soil air and in the house over time, both with and without basement depressurization. Depressurization was seen to have a substantial effect on the migration of the tracer within the soil. For basement depressurizations of 25-50 Pa, effective transport velocities through the soil and into the houses were observed to exceed 1 m h^{-1}. Airborne ^{222}Rn concentration was monitored in the basement of one house during the 6-day investigation and was seen to increase substantially on each of the seven occasions that the house was depressurized. The techniques employed are applicable to the study of problems of excessive radon entry into buildings and the migration of toxic vapors from waste dumps and landfills.

5105 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 41694

41985 **(EGG—10282-2159) An assessment of techniques for monitoring San Joaquin kit fox population abundance on Naval Petroleum Reserve No. 1, Kern County, California.** Harris, C.E. (EG and G Energy Measurements, Inc., Goleta, CA (USA). Santa Barbara Operations). Apr 1987. Contract AC08-83NV10282. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87012715.

The monitoring of San Joaquin kit fox (Vulpes macrotis mutica) population abundance on Naval Petroleum Reserve No. 1 (NPR-1) by the US Department of Energy (DOE) is one aspect of compliance with the Endangered Species Act of 1973. Monitoring of the kit fox population is essential to determine the need for specific management programs, to assess the impacts of development activities, to evaluate the results of specific management programs, and to gather information on kit fox biology and ecology as they relate to other aspects of the NPR-1 environment. Several techniques are available to monitor population abundance, but the choice of methods used is dependent upon the specific objectives of the monitoring program. The inherent problem with most available techniques is the lack of uniformity of procedures and statistical repeatability, and the need for validation of indices and population estimates against known populations. If sufficient numbers of foxes can be captured, closed population models using capture-recapture data provide reasonable estimates of population size. Capture data can also be used to determine the minimum trappable population, and the minimum population size during those sessions when fewer than 40 foxes are trapped. The scent-station survey is the best method available for estimating relative kit fox abundance.

41986 **(UCRL—15864) A rare plant survey of Site 300, Lawrence Livermore National Laboratory, San Joaquin County, California.** Taylor, D.W.; Davilla, W. (BioSystems Analysis, Inc., Santa Cruz, CA (USA)). Nov 1986. Contract W-7405-ENG-48. 38p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011343.

Site 300 supports a diverse array of grassland communities typical of lowland central California. This report describes the results of a rare plant inventory of Site 300 and relates findings to potential environmental impacts of operating and possibly expanding on-site facilities.

41987 **(UCRL—15865) Wildlife studies of Site 300 emphasizing rare and endangered species: Lawrence Livermore National Laboratory, San Joaquin County, California.** Orloff, S. (BioSystems Analysis, Inc., Sausalito, CA (USA)). Nov 1986. Contract W-7405-ENG-48. 59p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87011344.

The primary purpose of this project was to determine the presence and status of any endangered, threatened, fully protected, or otherwise sensitive wildlife species on Site 300 that might be affected by Site operations and developments. We directed our studies mainly toward the federally endangered San Joaquin kit fox (Vulpes macrotis mutica), but also toward another 15 special status species that potentially occur on site, including the state threatened Alameda striped racer (Masticophis lateralis euryxanthus).

5106 Regulations

REFER ALSO TO CITATION(S) 41094, 42034

41988 **(AD-A—180377/4/XAB) Shorelands: General Policies Plan Amendment 83-23, Zone Change Application 83-24. Draft report.** (Cole/Mills Associates, Martinez, CA (USA)). Mar 1987. 453p. NTIS, PC A20/MF A01.

Original contains color plates: All DTIC and NTIS reproductions will be in black and white. See also Volume 2, AD-A180378.

This is a joint State/Federal environmental impact document concerning a regulatory permit application by The Shorelands Corp. under Section 10 of the River and Harbor Act of 1899 and Section 404 of the Clean Water Act. The proposed project consists of the construction of a horse racetrack, industrial/office/commercial complex, and theme park on 736 acres of inactive salt ponds on the shoreline of the San Francisco Bay.

41989 **(AD-A—180378/2/XAB) Shorelands: General Policies Plan Amendment 83-23, Zone Change Application 83-24. Volume 2. Appendices. Draft report.** (Cole/Mills Associates, Martinez, CA (USA)). Mar 1987. 205p. NTIS, PC A10/MF A01.

See also AD-A180 377.

This is joint State/Federal environmental impact document concerning a regulatory permit application by The Shorelands Corp. under Section 10 of the River and Harbor Act of 1899 and Section 404 of the Clean Water Act. The proposed project consists of the construction of a horse racetrack, industrial/office/commercial complex, and theme park on 736 acres of inactive salt ponds on shoreline of the San Francisco Bay. Contents: Summary of site Alternative Analysis; Signalized Intersection Capacity Analysis; History of the Baumberg Tract; Cultural Overview; Applicant's Detail of Project Description.

41990 **(PB—87-193371/XAB) Guide for preparing RCRA (Resource Conservation and Recovery Act) permit applications for existing storage facilities.** (Kearney (A.T.), Inc., Alexandria, VA (USA)). 1982. 292p. NTIS, PC A13/MF A01.

The purpose of the preliminary guidance document is to assist the owners and operators of hazardous-waste-management facilities in the preparation of their Resource Conservation and Recovery Act (RCRA) Permit Applications. Its intent is to provide sufficient information and detail to enable a facility to submit an application; however, in some situations, certain regulations may not apply to every facility.

41991 **(PB—87-193389/XAB) Model permit for hazardous-waste treatment, storage, and disposal facilities.** (Environmental Protection Agency, Washington, DC (USA). Office of Solid Waste). 2 Apr 1984. 41p. NTIS, PC A03/MF A01.

The model permit was developed to provide a standard permit format for facilities that store, treat, or dispose of hazardous wastes. The model is divided into parts and will eventually cover all types of facilities that require permits under RCRA. At present, parts have been developed that cover permit conditions for tank and container storage and incinerators.

41992 **(PB—87-193397/XAB) Final draft guidance for Subpart G of the Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities. Final report.** Severn, R.R.; Leggett, N.; Neill, P.P.; Burt, R.E.; Chrisman, K. (General Research Corp., McLean, VA (USA). Management Systems Div.). Nov 1981. 243p. NTIS, PC A11/MF A01.

The purpose of this guidance document is to assist in implementing closure and post-closure plans. The document concentrates on the closure plans specific to six types of Treatment, Storage, or Disposal Facilities (TSDF): tanks; surface impoundments; land-treatment facilities; landfills; incinerators; and multiple-process facilities. This document clarifies the concepts, definitions, and rationale behind the requirements; identifies the major issues that affect closure and post-closure requirements; discusses site-specific factors that affect closure and post-closure plans; clarifies the role of the Regional Office in evaluating these plans; provides guidance to owners or operators who need to develop closure and post-closure plans.

41993 **(PB—87-193694/XAB) Permit applicants' guidance manual for exposure information requirements under RCRA (Resource Conservation and Recovery Act) Section 3019. Final report.** (Environmental Protection Agency, Washington, DC (USA). Office of Solid Waste and Emergency Response). 3 Jul 1985. 67p. NTIS, PC A04/MF A01.

See also report dated Sep 86, PB—87-193702.

The purpose of this document is to provide owners and operators of hazardous-waste landfills and surface impoundments that are subject to permitting under the Resource Conservation and Re-

covery Act (RCRA) with guidance for submitting information on the potential for public exposure to hazardous wastes, as required by Section 3019 of RCRA.

41994 **(PB—87-193702/XAB) Procedural guidance for reviewing exposure information under RCRA (Resource Conservation and Recovery Act) section 3019. Final report.** Grogan, T.; Kayser, R. (Environmental Protection Agency, Washington, DC (USA). Office of Solid Waste and Emergency Response). 26 Sep 1986. 67p. (OSWER—9523.00-2A). NTIS, PC A04/MF A01.

See also report dated Jul 85, PB—87-193694.

This guidance manual describes the procedures for permit writers in evaluating exposure information submitted under Resource Conservation and Recovery Act (RCRA) Section 3019. The integration of the review with existing RCRA permitting activities is also discussed. The document outlines procedures to follow in referring sites to the Agency for Toxic Substances and Disease Registry (ATSDR) for health evaluations.

41995 **(PB—87-193710/XAB) RCRA (Resource Conservation and Recovery Act) ground-water monitoring compliance order guidance. Final report.** (Environmental Protection Agency, Washington, DC (USA). Office of Solid Waste and Emergency Response). Aug 1985. 128p. NTIS, PC A07/MF A01.

The purpose of this document is to guide enforcement officials in developing administrative orders to address Resource Conservation and Recovery Act (RCRA) ground-water monitoring violations at interim-status land-disposal facilities. The document's primary objective is to promote the development of orders that correct interim-status violations in a manner that is consistent with the needs of the RCRA permitting process. The document concentrates on how to fashion ground-water remedies for facilities operating during the transition period between interim status and permitting.

41996 **(PB—87-194130/XAB) Regional guidance manual for selected interim status requirements. Draft report.** (Mitre Corp., McLean, VA (USA)). 22 Sep 1980. 222p. NTIS, PC A10/MF A01.

The purpose of the manual is to assist EPA's Regional Offices in interpreting selected requirements of the Interim Status Standards (ISS) for facilities managing hazardous waste. The ISS were promulgated under the authority of Section 3004 of the Resource Conservation and Recovery Act of 1976 (RCRA) and were published in the Federal Register on May 19, 1980 (45FR98: 33063). The document provides background information and general guidance to aid permitting officials in evaluating responses to certain of the interim-status regulations.

52 ENVIRONMENTAL SCIENCES, AQUATIC

5201 Basic Studies

REFER ALSO TO CITATION(S) 40449, 40452, 41950

41997 **(DOE/ER/60515—1-Pt.1) Dissolved organic matter and lake metabolism: Biogeochemistry and controls of nutrient flux dynamics in lakes: Technical progress report, 1 July 1986-30 June 1987.** Wetzel, R.G. (Michigan Univ., Ann Arbor (USA). Dept. of Biology). 1987. Contract FG02-87ER60515. 51p. (COO—1599-308-Pt.1). NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87012142.

Most lakes are small and possess large littoral and wetland components in the interface region between the open water per se and the drainage basin. Not only does the photosynthetic productivity of the surrounding littoral-wetland complex vastly exceed that of the pelagic zone, but the littoral-wetland vegetation and its intensive synthesis and decompositional metabolism regulate loading of inorganic nutrients passing to the open water (functioning as pulsed sources and sinks), and regulate loading of dissolved organic matter and particulate organic matter to the recipient open water, which by numerous complex pathways and mechanisms enhance or suppress pelagic productivity. Research emphasis was placed on the sources, fates, and interactions of dissolved and particulate organic matter in relation to inorganic chemical cycling: allochthonous loading to the lake system; and the coupled nutrient physiology and metabolism of phytoplankton, bacterial populations, macrophytes and attendant sessile algal-bacterial communities. Regulatory mechanisms of growth and rates of carbon and nutrient cycling were evaluated among the inorganic-organic influxes of allochthonous sources as they are controlled by wetland-littoral communities, the littoral photosynthetic producer-decomposer complex, the microflora of the sediment-water interface, and the microflora of the pelagic zone. 28 refs., 13 figs., 2 tabs.

41998 **(DOE/ER/60515—T1-Pt.3) Seasonal dynamics, alkaline phosphatase activity and phosphate uptake of adnate and loosely attached epiphytes in an oligotrophic lake.** Burkholder, J.M. (Michigan State Univ., East Lansing (USA). Dept. of Botany and Plant Pathology). 1986. Contract FG02-87ER60515. 349p. (COO—1599-308-Pt.3). Dept. of Botany & Pathology, Univ. of Mich., Ann Arbor, MI 48109. File Number TI87012143.

This research characterizes the seasonal dynamics of algal epiphytes throughout an annual cycle and examines potential major sources of algal phosphorus. In a phosphorus-limited hardware lake, epiphytic microflora consisted almost entirely of diatoms and blue-green algae, and community structure fluctuated temporally and spatially (with age of macrophyte tissue). Epiphytic ATP was greatest during initial colonization of new macrophyte ramets, and was not correlated with algal biomass except on oldest leaf tissue. Epiphytic chlorophyll was determined primarily by blue-green algal biomass, except on oldest leaf tissue and during colder periods. Epiphytic alkaline phosphatase activity on new and aging macrophyte leaves was significantly less than that on artificial plants, indicating that algae on natural plants were less phosphorus-limited and had obtained a portion of their phosphorus from the macrophytes. Collaborative research quantified the importance of macrophytes as a phosphorus source for algal epiphytes. The author examined the importance of position in determining nutrient availability within the epiphyte matrix. Following short-term assays, scanning electron microscopy (SEM)- and LM-autoradiography were used to directly compare uptake of ^{33}P-phosphate from the water by intact adnate vs. loosely attached algae, respectively. Loosely attached algae took up significantly more phosphate from the water than did underlying adnate cells, after long-term community acclimation to either phosphorus-poor or phosphorus-enriched conditions.

41999 **(DOE/ER/60515—T1-Pt.4) Oxygen dynamics in periphyton communities and associated effects on phosphorus release from lake sediments.** Carlton, R.G. (Michigan State Univ., East Lansing (USA). Dept. of Zoology). 1986. Contract FG02-87ER60515. 85p. (COO—1599-308-Pt.4). NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87012144.

Periphyton is typically a heterogeneous assemblage of filamentous and single celled photoautotrophic and heterotrophic microorganisms suspended in a mucopolysaccharide matrix which they produce. By definition, the assemblage is attached to a substratum such as rock, sediment, or plant in an aquatic environment. Microtechniques with high spatial and temporal resolution are required to define metabolic interactions among the heterotrophic and autotrophic constituents, and between periphyton and its environment. This study used oxygen sensitive microelectrodes with tip diameters of < 30 μm to investigate the effects of photosynthesis and respiration on the oxygen dynamics of several diverse periphyton communities both in situ and in laboratory microcosms. A novel flow-through system that utilized ^{32}P radiotracer and that permitted manipulation of the velocity, flushing rate, and oxygen concentration of overlying water was developed to investigate the role of photosynthetic oxygen production on the phosphorus dynamics in lake sediments colonized by epipelic periphyton. 89 refs., 20 figs.

42000 **(PB—87-192191/XAB) Feeding ecology of gray whales in the Chirikof Basin.** Thomson, D.H.; Martin, L.R. (National Ocean Service, Anchorage, AK (USA). Ocean Assessments Div.). 1984. 83p. NTIS, PC A99/MF A01.

Contents include: Description and distribution of gray whale feeding features; Food removal by gray whales; Utilization of the Chirikof Basin by gray whales.

42001 **(PB—87-192209/XAB) Investigations of belukha whales in coastal waters of western and northern Alaska, 1982-1983: marking and tracking of whales in Bristol Bay.** Frost, K.J.; Lowry, L.F.; Nelson, R.R. (National Ocean Service, Anchorage, AK (USA). Ocean Assessments Div.). Dec 1983. 115p. NTIS, PC A99/MF A01.

A 2-year study was conducted in Bristol Bay, Alaska, to develop and test techniques for marking belukha whales with visual and radio tags. Information was also gathered on belukha distribution and abundance, foods and feeding, and rates and causes of mortality. Two types of radio packages were developed: an OAR backpack designed to be bolted through the dorsal ridge, and a Telonics barnacle tag with an umbrella-stake attachment. Testing of tags and attachments revealed that the more-powerful OAR radio could be received at longer distances and lower antenna heights, and the the umbrella-stake attachment penetrated too deeply for reliable use on belukhas.

42002 **(PB—87-192241/XAB) Ecological studies of intertidal and shallow subtidal habitats in lower Cook Inlet, Alaska.** Lees, D.C.; Houghton, J.P.; Erickson, D.E.; Driskell, W.B.; Boettcher, D.E. (National Ocean Service, Anchorage, AK (USA). Ocean Assessments Div.). 1980. 427p. NTIS, PC A99/MF A01.

Field studies were conducted from May 1976 to November 1979 in intertidal and shallow subtidal habitats in lower Cook Inlet and the Northeast Gulf of Alaska (NEGOA) to examine species composition, zonation, seasonal patterns, trophic structure, rates of production, and energy pathays. Habitats examined included rocky intertidal and subtidal areas, sand beaches and mud flats (Dames & Moore 1976a, 1979b).

42003 **(PB—87-192266/XAB) Outer Continental Shelf environmental assessment program. Final reports of principal investigators. Volume 45.** (National Ocean Service, Anchorage, AK (USA). Ocean Assessments Div.). Jul 1986. 748p. NTIS, PC A99/MF E04.

See also Volume 44, PB—87-192233, Volume 46, PB—87-194932, and PB—87-192274 through PB—87-192407.

Contents include: Pelagic distribution of marine birds of the north Aleutian Shelf and analysis of encounter probability; The breeding biology and feeding ecology of marine birds in the Gulf of Alaska; Feeding ecology of marine birds in the nearshore waters of Kodiak Island; Diets and food web relationships of seabirds in the Gulf of Alaska and adjacent marine region.

42004 **(PB—87-192399/XAB) Feeding ecology of marine birds in the nearshore waters of Kodiak Island.** Krasnow, L.D.; Sanger, G.A. (National Ocean Service, Anchorage, AK (USA). Ocean Assessments Div.). Sep 1982. 123p. NTIS, PC A99/MF E04.

The feeding habits of marine birds in the nearshore waters of Kodiak Island were studied during winter 1976-1977 and February 1978 and during summer 1977 and 1978. The authors' goals were to determine which prey were important to each species of bird and to define geographic, seasonal, and annual patterns of prey use. A total of 1,167 birds of 10 species were collected during the two-year study. During both winters, oldsquaws and Steller's elders ate a broad range of invertebrate prey, and common murres ate primarily gadids. Marbled murrelet feeding habits varied between the two winters. Due to the complexity of the fate and effects of petroleum, it is difficult to predict the impacts of a spill.

42005 **(PB—87-192407/XAB) Diets and food-web relationships of seabirds in the Gulf of Alaska and adjacent marine regions.** Sanger, G.A. (National Ocean Service, Anchorage, AK (USA). Ocean Assessments Div.). Jan 1983. 139p. NTIS, PC A99/MF E04.

Overall diets of 39 species of marine birds (four procellariiforms, three cormorants, six sea ducks, one phalarope, two jaegers, 17 gulls, two terns, and 13 alcids) inhabiting the Gulf of Alaska and adjacent marine regions are summarized with food-web diagrams, tables, and text. Diets of the Northern Fulmar, Sooty and Short-tailed Shearwaters, Pelagic Cormorant, Black-legged Kittiwake, Common and Thick-billed Murres, Marbled and Kittlitz's Murrelets, and Horned and Tufted Puffins are compared among seasons and geographic regions.

42006 **(PNL—6286) Secondary production of benthic insects in three cold-desert streams.** Gaines, W.L. (Pacific Northwest Lab., Richland, WA (USA)). Jul 1987. Contract AC06-76RL01830. 55p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87013122.

Aquatic insect production was studied in three cold-desert streams in eastern Washington (Douglas Creek, Snively Springs, and Rattlesnake Springs). The size-frequency method was applied to individual taxa to estimate total insect production. production was also assessed for functional groups and trophic levels in each stream. Optioservus sp. (riffle beetles) and Baetis sp. (mayflies) accounted for 72% of the total insect numbers and 50% of the total biomass in Douglas Creek. Baetis sp. accounted for 42% of the total insect numbers and 25% of the total biomass in Snively Springs. Simulium sp. (blackflies) and Baetis sp. comprised 74% of the total insect numbers and 55% of the total biomass in Rattlesnake Springs. Grazer-scrapers (49%) and collectors (48%) were the most abundant functional groups in Douglas Creek. Collectors were the most abundant functional group in Snively Springs and Rattlesnake Springs. Herbivores and detritivores were the most abundant trophic level in Snively Springs and Rattlesnake Springs. Dipterans (midges and blackflies) were the most productive taxa within the study streams, accounting for 40% to 70% of the total community production. Production by collectors and detritivores was the highest of all functional groups and trophic levels in all study streams.

5202 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 40397, 40441, 40442, 40443, 40444, 40445, 40446, 40447, 40448, 40450, 40451, 40453, 40454, 40456, 41459, 41474, 41475, 41485, 41888, 41939, 41953, 41958, 41959, 41962, 41973, 42255, 42275

42007 **(AD-A—180202/4/XAB) Wastewater treatment plant evaluation, McGuire AFB, New Jersey. Final report, 3-17 November 1986.** Slavich, F.E. (Air Force Occupational and Environmental Health Lab., Brooks AFB, TX (USA)). Mar 1987. 37p. (USAFOEHL—87-038EQ0121CSC). NTIS, PC A03/MF A01.

The USAFOEHL conducted a survey evaluating the wastewater treatment facility at McGuire AFB, New Jersey. The scope of the survey included the evaluation of: (1) individual-treatment-plant unit processes, (2) influent and effluent sewage quality, (3) treatment plant flow rates, and (4) operational and maintenance practices. Results of the survey showed that the plant was not meeting the 7-day NJPDES effluent standard for Total Phenols, Total Suspended Solids (TSS), and removal efficiency for TSS. Overall, the unit processes of the plant are performing adequately; notwithstanding correctable operation and maintenance difficulties. Recommendation: (1) Perform daily jar testing at the plant. (2) Clean the chlorine contact chamber. (3) Substitute EPA method 604 for EPA method 423 in determining effluent phenol concentration, if possible. (4) Repair the gaps between the clarifier walls and the overflow weirs. (5) Increase the trickling filter recirculation during periods of low influent flow. (6) Consider construction of an aerate wastewater equalization basin.

42008 **(AD-A—180246/1/XAB) Water-quality data: US Air Force Plant Number 4, Fort Worth, Texas. Report for May 1985-May 1986.** (Hargis and Associates, Inc., La Jolla, CA (USA)). 15 May 1986. 337p. NTIS, PC A15/MF A01.

Includes envelope with one map.

Appendices: (A) results of analyses for common ion constituents in water samples; (B) Results of analyses for trace metal constituents and cyanide in water samples; (C) Results of analyses for

EPA priority volatile organic compounds in water samples collected from monitor wells; (D) Concentration of base/neutral organic compounds in water samples collected from monitor wells; (E) Results of analyses for EPA priority acid organic compounds in water samples collected from monitor wells; (F) Concentration of nonpriority and semiquantified organic compounds in water samples; (G) Concentration of oil/grease and fuel hydrocarbons in water samples collected from monitor wells; (H) Results of analyses for EPA priority pesticide components in water samples.

42009 **(CONF-870937—2) Behavior and fish uptake of mercury in a contaminated stream.** Elwood, J.W.; Turner, R.R.; Cook, R.B.; Bogle, M.A. (Oak Ridge Y-12 Plant, TN (USA); Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 5p. NTIS, PC A02. File Number DE87010380.

From 6. international conference on heavy metals in the environment; New Orleans, LA, USA (15 Sep 1987).

The behavior and biological uptake of mercury were investigated at several sites in a contaminated stream to determine whether elevated mercury levels in fish native to the stream are due to current or historic releases of mercury from an industrial facility located at the headwaters of the drainage. The concentrations of both total and dissolved mercury in stream water and mercury levels in surface sediments were highest at the inlet to a holding pond through which the stream flows at the facility boundary. Levels decreased with increasing distance downstream of the pond. Methyl mercury in water was higher at the pond outlet than at the inlet and decreased to below the detection limit 5.3 km downstream of the pond outlet. Rates of methylation in sediment suspensions estimated using the radiotracer ^{203}Hg were low at all sites and followed a pattern similar to that of methyl mercury in water. The mercury uptake rate by fish held in cages and introduced into the stream was also highest immediately downstream of the pond, second highest at the pond inlet, and decreased with distance downstream of the pond. The results indicate that total mercury in sediments and water are not reliable variables for predicting the rate of mercury uptake by fish, and that the longitudinal gradient in mercury contamination in native fish is due primarily to ongoing releases of inorganic mercury from the plant area and subsequent transformation of some of the mercury of methyl mercury, particularly in the pond.

42010 **(CONF-870937—3) Aluminum forms in stream sediment: Relation to bedrock geology and water chemistry.** Turner, R.R.; Bogle, M.A.; Zeiler, M.A.; Mulholland, P.J.; Elwood, J.W.; Cook, R.B. (Electric Power Research Inst., Palo Alto, CA (USA); Oak Ridge National Lab., TN (USA); Carleton Coll., Northfield, MN (USA)). 1987. Contract AC05-84OR21400. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010907.

From 6. international conference on heavy metals in the environment; New Orleans, LA, USA (15 Sep 1987).

Longitudinal gradients in sediment and water chemistry were characterized in a high elevation stream in the southern Appalachian Mountains, USA, to elucidate the geochemical behavior of aluminum across gradients in pH (4.5 to 6.5) and elevation (1120 to 1895 m). Observed gradients are driven in part by the presence of pyritic bedrock, which occurs at higher elevations and yields acidity when exposed to oxidation by landslide activity. Exchangeable Al in sediment (estimated using potassium chloride) varied in response to monomeric Al in streamwater and thus decreased downstream. Organic Al in sediment (estimated using sodium pyrophosphate) did not vary in proportion to the organic carbon content of sediment. Amorphous Al in sediment (estimated as the difference between oxalate- and pyrophosphate-extractable Al) and Al extractable with acidified streamwater (pH 4.5) was lowest at the more acidic sites. These results suggest that increases in soluble Al in downstream reaches during episodic pH depressions could be due in part to the release of adsorbed and/or precipitated Al in sediment.

42011 **(DOE/ER/60197—10) Surging as a potential response of ice sheets to carbondioxide-induced changes in the polar environment (SPICAE): Final report.** Radok, U.; Lingle, C.S. (Colorado Univ., Boulder (USA). Cooperative Inst. for Research in Environmental Sciences). Jul 1987. Contract AC02-84ER60197. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012647.

The objectives and promises of the project are recalled and compared with the results achieved and products delivered. Products include a new physical description of the Antarctic ice sheet, extensive simulations of ice stream behavior with the only existing model of self-surging glaciers, and a description and test results of a new model of a floating ice shelf designed to be coupled to a model ice stream sliding over an aquifer. The main conclusion reached is that Antarctic ice streams are unlikely to undergo surges in the strict sense of the term - intermittent and periodic increases of their already high velocities by one or two orders of magnitude. However, the possibility of such surges must be explored further with improved parameterizations of the basal hydraulics, as achieved, e.g., in the aquifer sliding model.

42012 **(NP—7752777) International Commission for Protection of the Rhine against Water Pollution. Annual report 1985.** (Internationale Kommission zum Schutze des Rheins gegen Verunreinigung, Koblenz (Germany, F.R.)). 1986. 234p. (In German and French). NTIS (US Sales Only), PC A11. File Number DE87752777.

The 1985 report reviews the activities of the Commission and gives an outline of the water quality of the Rhine river and its development in the last few years.

42013 **(NP—7770193) Transport of suspended sediments in open channels.** Vetter, M. (Universitaet der Bundeswehr Muenchen, Neubiberg (Germany, F.R.). Inst. fuer Wasserwesen). 1987. 187p. (In German). NTIS (US Sales Only), PC A09. File Number DE87770193.

In part 1 the mostly used theories for the vertical concentration distribution of suspended sediments are compared with measurements. The models are investigated with regard to aggreement with measurements, range of application and mathematical handling. Due to this arguments the main result was obtained, that an extended diffusion theory is the best possible solution from all models considered in this investigation. Part 2 presents numerous river measurements on which the investigations of part 1 are based.

42014 **(PB—87-188686/XAB) Acute toxicity handbook of chemicals to estuarine organisms.** Mayer, F.L. (Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab.). Apr 1987. 283p. (EPA—600/8-87/017). NTIS, PC A13/MF A01.

All acute toxicity data developed by the Gulf Breeze Environmental Research Laboratory, U.S. Environmental Protection Agency, since 1961 were evaluated for quality. A data base was established for 1175 tests with 197 chemicals and 52 species of estuarine organisms. The chemicals represent all major groups of pesticides, as well as numerous industrial and inorganic chemicals.

42015 **(PB—87-188702/XAB) National Surface Water Survey, National Stream Survey, pilot survey, field operations report.** Knapp, C.M.; Mayer, C.L.; Peck, D.V.; Baker, J.R.; Filbin, G.J. (Lockheed Engineering and Management Services Co., Inc., Las Vegas, NV (USA)). Apr 1987. 104p. NTIS, PC A06/MF A01.

The National Stream Survey (NSS) is one of the programs within the National Surface Water Survey of the U.S. Environmental Protection Agency. The report chronicles the activities required to plan and conduct the field operations of the NSS pilot survey. Preparatory activities for the NSS pilot survey are described, including the personnel training program and site reconnaissance activities. The equipment and protocols (including quality-assurance measures) used to collect water samples and field measurement of pH, conductivity, and dissolved oxygen are presented. Field-laboratory activities are summarized, including a protocol for preparing a fraction for analysis of organically-complexed monomeric aluminum species.

42016 **(PB—87-190542/XAB) Best management practices - effectiveness of retention/detention ponds for control of contaminants in highway runoff. Final report, January 1983-August 1986.** Yousef, Y.A.; Wanielista, M.P.; Harper, H.H.; Hvitved-Jacobsen, T. (University of Central Florida, Orlando (USA). Dept. of Civil Engineering and Environmental Sciences). Aug 1986. 151p. NTIS, PC A08/MF A01.

The fate of nutrients and heavy metals in highway runoff entering retention/detention ponds was studied. Investigations on characterization of highway runoff, water quality in receiving ponds and surrounding drainage basins, isolation chamber studies, accumulation of contaminants by bottom sediments, speciation of heavy metals in the sediments, release studies under various pH and redox potential and groundwater monitoring surrounding the pond area were carried out in two sites at Maitland Interchange and EPCOT Interchange located in Orange County, Central Florida. Removal efficiencies of nitrogen, phosphorus and heavy metals in a well-established pond operating for 7-8 years at Maitland site and a newly constructed pond at EPCOT site were evaluated. Most of the metals accumulated in the pond sediments are immobile under current conditions of pH and redox potential.

42017 **(PB—87-190666/XAB) Contamination of populated estuaries and adjacent coastal ocean--a global review. Technical memo.** Segar, D.A.; Davis, P.G. (National Ocean Service, Rockville, MD (USA). Office of Oceanography and Marine Assessment). Dec 1984. 131p. (NOAA/TM/NOS/OMA—11). NTIS, PC A07/MF A01.

A comparison of the contamination of coastal marine waters in the New York Bight with that of other populated coastal and estuarine marine areas demonstrates that the New York Bight does not appear to be more polluted, nor suffer from pollution impacts to any greater degree, than many other studied regions. Toxic contaminant levels, including concentrations of heavy metals and PCBs in sediments and water, found in the New York Bight are similar to those in many of the world's heavily populated coastal areas. The New York Bight is not among the most pollution-susceptible regions of the world ocean (e.g., Saronikos Gulf, Guanabara Bay, Brazil, and New York, Singapore, and Hong Kong harbors), but, instead, is comparable to the large, but poorly flushed, semi-enclosed seas (e.g., the Baltic, Mediterranean, Irish, North, and Seto Inland seas).

42018 **(PB—87-191664/XAB) Evaluation of pristine lignin for hazardous-waste treatment.** O'Neil, D.J.; Newman, C.J.; Chian, E.S.K.; Gao, H. (Georgia Inst. of Tech., Atlanta (USA)). May 1987. 212p. NTIS, PC A10/MF A01.

A feasibility study was conducted to assess the utilization of lignin, isolated from a steam-exploded hardwood (Tulip poplar) with 95% ethanol and 0.1n NaOH, as a potential adsorbent for hazardous-waste treatment. Eight organic compounds and two heavy metals were selected to allow comparison of lignin isolates with activated carbon. It was found that the adsorption capacity of lignin for heavy metals (chromium and lead) is comparable to activated carbon, despite a huge divergence in surface area (0.1 m^2/g vs. 1000 m^2/g). The surface area discrepancy and the extensive aromatic substitution in lignin macromolecule impeded the achievement of an adsorption capacity of lignin for polar organic compounds which would allow it to be cost-competitive with activated carbon although results with phenol and, to a lesser degree, naphthalene indicate significant potential for achieving competitive capacities. A recommended plan for surface area and structural enhancement is presented on the basis that lignin can be developed as an effective and low-cost adsorbent for polar priority pollutants and/or as an ion-exchange resins for heavy-metal wastewater clean-up.

42019 **(PB—87-191698/XAB) Availability of PCBs (polychlorinated biphenyls) and PAHs (polycyclic aromatic hydrocarbons) to mytiluj edulis from artificially resuspended sediments.** Pruell, R.J.; Lake, J.L.; Davis, W.R.; Quinn, J.G. (Environmental Protection Agency, Narragansett, RI (USA). Environmental Research Lab.). 1987. 16p. (EPA—600/D-87/140). NTIS, PC A02/MF A01.

Pub. in Oceanic Processes in Marine Pollution, Volume 1, Biological Processes and Wastes in the Ocean, 97-108(1987).

Estuarine sediment containing high levels of polychlorinated biphenyls (PCBs) and polycyclic aromatic hydrocarbons (PAHs) was resuspended into a flowing seawater system. Analysis of the dissolved and particulate phases in the exposure tank indicated a release of some low molecular weight PCB and PAH compounds from the sediment. Both classes of compounds were rapidly incorporated by blue mussels, Mytilus edulis maintained in the system, reaching an apparent equilibrium concentration after twenty days of exposure. The distribution of both classes of compounds accumulated in the mussels suggested selective absorption of specific fractions.

42020 **(PB—87-192662/XAB) Polynuclear aromatic hydrocarbon contamination in sediments from coastal waters of southern California (revised March 1987). Final report.** (Southern California Coastal Water Research Project Authority, Long Beach (USA)). 20 Mar 1987. 114p. NTIS, PC A06/MF A01.

The study was designed to sample sediment from Santa Monica Bay to San Diego Bay suspected of containing high amounts of aromatic hydrocarbons. The sites included a reference station (San Mateo Point) and several river stations to provide a wider view of the range of contaminant levels in the region. The primary objective of the study was therefore to confirm analytical data on PAH concentrations reported in previous studies at a few stations and to extend the survey to many sites receiving non-point source inputs of contaminants. These results will provide an overview of the relative nature of PAH contamination at 24 sites in southern California receiving a wide range of contaminant inputs and allow the State Water Resources Board and the Regional Water Quality Control Boards to focus their concern on sites requiring further investigation.

42021 **(PB—87-194247/XAB) Improving the reliability of compartmental models: case of conceptual hydrologic rainfall-runoff models. Research project report.** Sorooshian, S.; Gupta, V.K. (Arizona Univ., Tucson (USA). Dept. of Hydrology and Water Resources). Aug 1986. 306p. NTIS, PC A14/MF A01.

The objective of the research project was to investigate methods for improving the reliability of compartmental models such as conceptual rainfall-runoff models. The study focused on the structural nonidentifiability problems of such models that have been observed to cause severe parameter-estimation difficulties. In particular, the problems arising due to the threshold nature of some parameters were investigated. Three new mathematical procedures were developed. One is a new objective function for rainfall-runoff models that was developed using likelihood theory and based on the error structure arising due to the nonlinear nature of the rating curve.

42022 **Chromate adsorption on amorphous iron oxyhydroxide in the presence of major groundwater ions.** Zachara, J.M.; Girvin, D.C.; Schmidt, R.L.; Resch, C.T. (Battelle, Pacific Northwest Labs., Richland, WA). *Environmental Science and Technology;* **21**: No. 6, 589-594(Jun 1987).

Chromate adsorption on amorphous iron oxyhydroxide was investigated in dilute iron suspensions as a single solute and in solutions of increasing complexity containing $CO_2(g)$, $SO_4^{2-}(aq)$, $H_4SiO_4(aq)$, and cations [K^+, Mg^{2+}, $Ca^{2+}(aq)$]. In paired-solute systems (e.g., CrO_4^{2-}-$H_2CO_3^*$), anionic cosolutes markedly reduce CrO_4^{2-} adsorption through a combination of competitive and electrostatic effects, but cations exert no appreciable influence. Additionally, H_4SiO_4 exhibits a strong time-dependent effect: CrO_4^{2-} adsorption is greatly decreased with increasing H_4SiO_4 contact time. In multiple-ion mixtures, each anion added to the mixture decreases CrO_4^{2-} adsorption further. Adsorption constants for the individual reactive solutes were used in the triple-layer model. The model calculations are in good agreement with the CrO_4^{2-} adsorption data for paired- and multiple-solute systems. However, the model calculations underestimate CrO_4^{2-} adsorption when surface site saturation is approached. Questions remain regarding the surface interactions of both $CO_2(aq)$ and H_4SiO_4. The results have major implications for the adsorption behavior of CrO_4^{2-} and other oxyanions in subsurface waters.

42023 **Humic substances reduce bioavailability and toxicity of contaminants.** McCarthy, J.F. (Oak Ridge National Lab., Oak Ridge, TN). pp 286-287 of Proceedings of the symposia of the division of environmental chemistry of the American Chemical Society. Washington, DC; American Chemical Society (1987). (CONF-870410—). Contract AC05-84OR21400.

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

The humic substances reduce the bioaccumulation and toxic effects of nonionized organic contaminants in aquatic systems. The effect appears to be due to the inability of compounds associated with the humic macromolecule to cross biological membranes. If the affinity of a compound for associating with the organic matter in a natural water is known, then straightforward physico-chemical calculations can predict the amount of contaminant bound to the humics and thus unavailable for uptake. The effects of humic substances on the accumulation and toxicity of metals is poorly understood due to the complexity of metal-humic interactions, complexation with inorganic ions in water, and limited understanding of the toxicology of metals. Further research is needed to improve the author's capacity to accurately predict the fate and effects of contaminants in aquatic systems.

42024 **Humic substances reduce the uptake of organic contaminants by the gills of rainbow trout (Salmo gairdneri).** Black, M.C.; McCarthy, J.F. (Oak Ridge National Lab., Oak Ridge, TN). pp 296-298 of Proceedings of the symposia of the division of environmental chemistry of the American Chemical Society. Washington, DC; American Chemical Society (1987). (CONF-870410—). Contract AC05-84OR21400.

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

Dissolved organic material (DOM) is found in natural aquatic systems in concentrations ranging from 0.5-50 mg carbon/liter. DOM, including humic substances, will form soluble complexes with hydrophobic organic compounds (HOC). The binding affinity of DOM for these compounds is proportional to the compound's hydrophobicity. Thus, binding to DOM can reduce the concentration of freely dissolved HOC in the water. In this study the authors investigated the effect of DOM on the uptake of a model HOC, benzo(a)pyrene (BaP), by the gills of rainbow trout (Salmo gairdneri) to test the hypothesis that HOC bound to DOM is not available for uptake by the gills. Reductions in the concentration of freely dissolved BaP with increasing DOM concentrations should result in quantitatively equivalent reductions in gill uptake of BaP. By binding to HOC and thereby reducing the fraction of freely dissolved compound in the water, DOM reduces the uptake of HOC via respiratory membranes of aquatic organisms. The resulting reduction in contaminant dose can be predicted from physico-chemical measurements of the sorbent (DOM) and the contaminant, with dose reductions being proportional to the compound's affinity for binding to DOM. These sorptive interactions decrease the quantities of bioavailable contaminant, and should be accounted for when assessing the potential bioaccumulation of hydrophobic contaminants by organisms in natural aquatic systems.

42025 **Renovation of dilute process wastewaters; mini-pilot plant evaluation of an integrated process system to meet the clean water act's heavy metal and organic treatment requirements at Oak Ridge National Laboratory.** Begovich, J.M.; Brown, C.H.; Thompson, W.T.; Villiers-Fisher, J.F.; Patrick, G.C.; Snider, E.H. (Oak Ridge National Lab., Oak Ridge, TN). pp 17-30 of Proceedings of the 47th annual international water conference. Pittsburgh, PA; Engineers Society of Western Pennsylvania (1986). (CONF-861066—).

From 47. international water conference; Pittsburgh, PA, USA (27 Oct 1986).

IWC-86-4.

The purpose of the MPP was to simulate the treatment the ORNL nonradiological wastewaters will receive in the NRWT plant. In the MPP, all wastewaters, with the exception of those not containing heavy metals (i.e., Cd, Cr, Cu, Fe, Pb, Hg, Ni, Ag, and Zn), flowed through an API-type separator. The criteria metals (except for mercury) were removed in the reactor/clarifier (R/C) as hydroxide precipitates using either calcium hydroxide (lime) and sodium carbonate (soda ash) or sodium hydroxide (caustic). Overflow from the precipitator was then treated by dual-media (sand and anthracite) filters and adjusted to a pH of 7. Wastewaters that had been pretreated by ion exchange for radionuclide removal bypassed the first four unit operations and were combined with the other wastewaters prior to air stripping. The remainder of this paper details: the results of selected bench-scale treatability studies; spiking of feed streams; the MPP flowsheet and description of equipment; the results from the two MPP campaigns; and finally, the conclusions formulated by this treatability work.

5203 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 40500, 40502, 40509, 40512, 40542, 40564, 40565, 40601, 40602, 40605, 40606, 40608, 40609, 40610, 41020, 41937, 41938, 41939, 41973

42026 **(INIS-BR—656) Uranium and thorium of ground water in Pocos de Caldas, Brazil.** Bonotto, D.M. (UNESP, Rio Claro, Brazil. Inst. de Geociencias e Ciencias Exatas). (Sociedade Brasileira de Geofisica, Rio de Janeiro). 1985. 1p. (In Portuguese). (CONF-8511295—3-Summ.). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702764.

From 1. regional meeting of geophysics; Sao Jose dos Campos, Brazil (27 Nov 1985).

Published in summary form only.

42027 **(INIS-BR—663) Hydrogeochemical applications of natural isotope of the U (4n+2) and Th(4n) series in Morro do Ferro, Pocos de Caldas (MG), Brazil.** Bonotto, D.M. (Sao Paulo Univ. (Brazil). Inst. Astronomico e Geofisico). 1987. 403p. (In Portuguese). NTIS (US Sales Only), PC A18/MF A01. File Number DE87702771.

Uranium and thorium isotopic analysis were performed on well spoils of the ore body at Morro do Ferro, Pocos de Caldas (MG), Brazil, using groundwater from several boreholes in the area and surface water from a stream and that originates at the base of the hill. For uranium and thorium extraction, a chemical process was applied to samples; activites of ^{228}Th and ^{232}Th radioisotopes (4n+2 series) were determined by alpha spectrometry. The uranium concentration and ^{234}U/^{238}U isotope ratio in groundwater were applied to developed models for deducing proportions of water in a mixture and for characterizing uranium accumulation. The correlation between variability in concentration of uranium dissolved in groundwater and alteration of the level of the water table due to infiltration of rainfall was observed. Chemical analysis of the major and minor compounds for groundwater of the ore body zone were done.

5204 Thermal Effluents Monitoring And Transport

REFER ALSO TO CITATION(S) 41888, 42031

42028 **(DPST—86-798) Distribution and abundance of ichthyoplankton in the mid-reaches of the Savannah River and selected tributaries.** Paller, M.H.; Saul, B.M.; Osteen, D.V. (Environmental and Chemical Sciences, Inc., Aiken, SC (USA)). Mar 1986. Contract AC09-76SR00001. 219p. (ECS-SR—27). NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE87012941.

The objective of this study was to assess spawning activity and ichthyoplankton distribution upstream and downstream from the Savannah River Plant (SRP) in order to evaluate the possible impact of existing and proposed thermal discharges and the removal of river water for secondary cooling of nuclear reactors. Special emphasis was placed on evaluating ichthyoplankton production in Steel Creek due to possible future impacts on this stream following the restart of L-Reactor. A total of 19,926 fish larvae and 15,749 fish eggs were collected during 1985. As in previous years, the dominant group was the Clupeidae (65% of all ichthyoplankton), which included the anadromous blueback herring and American shad and the nonanadromous threadfin and gizzard shad. Other abundant taxa were the sunfishes and spotted suckers. While important during 1983 and 1984, crappie and minnows were comparative-

ly minor components of the ichthyoplankton during 1985. The most abundant ichthyoplankton in Steel Creek were American shad, blueback herring, and darters. The high percentage and number of American shad and blueback herring indicate that the lower reaches of Steel Creek are a spawning area for these anadromous species.

42029 **(DPST—86-799) Effects of thermal discharges on the distribution and abundance of adult fishes in the Savannah River and selected tributaries: Annual report, November 1984-August 1985.** Paller, M.H.; Saul, B.M. (Environmental and Chemical Sciences, Inc., Aiken, SC (USA)). 1986. Contract AC09-76SR00001. 159p. (ECS-SR—28). NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE87012945.

A study of the juvenile and adult fish community in streams draining the SRP and in the Savannah River in the area of the SRP was conducted between September 1984 and September 1985. The major objectives were to examine the abundance and distribution of fishes near the Savannah River Plant in relation to thermal discharges into the river, creeks, and floodplain swamps and to determine the rate of impingement of adult and juvenile fishes on the intake screens at the SRP pumphouses. The most abundant fishes (excluding minnows) taken by electrofishing were the redbreast sunfish (41.6%), spotted sucker (8.8%), spotted sunfish (8.2%), largemouth bass (5.7%), bluegill (5.6%), and American eel (5.4%). The most abundant fishes taken by hoop netting were the flat bullhead (38.0%), channel catfish (11.9%), bluegill (9.4%), white catfish (7.9%), black crappie (6.5%), and redbreast sunfish (5.5%). Dominant species in the intake canals were the bluegill, redbreast sunfish, and black crappie. Dominant species in the nonthermal river were the redbreast sunfish, spotted sunfish, spotted sucker, largemouth bass, channel catfish, white catfish, and flat bullhead. Dominant species in the nonthermal creeks were fairly similar to river species except that the catfishes were not as well represented. The thermal river and creek habitats differed from the nonthermal habitats in having higher percentages (although often lower numbers) of channel catfish, white catfish, largemouth bass, and coastal shiner and a lower percentage of flat bullhead.

5205 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 41102

42030 (DOE/BP—725, pp 282-316) **Camas Creek (Meyers Cove) anadromous species habitat improvement plan.** May, B.E.; Rose, R.W. Sep 1986. NTIS, PC A 14. File Number DE87009928.

In Natural propagation and habitat improvement: Volume 2, Idaho: Annual and final reports, 1985.

This report represents an analysis of potential enhancement and management options designed to improve instream and riparian zone conditions in the Meyers Cove area of Camas Creek. The efforts expended will contribute to improvement of anadromous species spawning, incubation and rearing habitat. Potential production increases would provide some compensation for hydropower effects in other areas of the Columbia River basin. The overall project has been divided into two separate but interrelated phases. This first phase was designed to provide an assessment of enhancement options, potential schedules, and costs associated with the enhancement options. The second phase will involve implementation of actual enhancement measures and associated monitoring to verify fish response. The combined phases are intended to meet the stated project goal. To improve riparian and instream conditions of Camas Creek in the Meyers Cove area to increase spring chinook and steelhead trout spawning and rearing production potential. To assist in achieving the above goal, this feasibility and design phase was funded, in part, by the Bonneville Power Administration (BPA). The project is a cooperative effort involving the US Forest Service (USFS), Idaho Department of Fish and Gas (IDFG), and the BPA.

42031 **(DPST—86-795) Savannah River Aquatic Ecology Program: Volume 3, Macroinvertebrates periphyton and water quality: Annual report, October 1983-September 1984.** O'Hop, J.R.; Tilly, L.J.; Chimney, M.J.; Painter, W.B. (Environmental and Chemical Sciences, Inc., Aiken, SC (USA)). Dec 1985. Contract AC09-76SR00001. 326p. (ECS-SR—23). NTIS, PC A15/MF A01; 1; GPO Dep. File Number DE87013033.

This report presents data on: (1) the taxonomic composition, biomass, and density of macroinvertebrates which colonize artificial substrate samplers; (2) the taxonomic composition and densities of macroinvertebrates in the drift communities of the Savannah River and five tributary creeks; (3) the biomass and chlorophyll a content of periphyton communities that colonize artificial substrates; (4) water quality data for selected parameters in the Savannah River and major tributary creeks upstream, downstream and in the vicinity of the SRP; and (5) the possible impacts of the existing and proposed SRP thermal discharges on the macroinvertebrate and periphyton communities of the Savannah River and tributary creeks.

42032 **(DPST—86-800) The Savannah River Aquatic Ecology Program: Macroinvertebrates, periphyton, and water quality: Final report, October 1984-September 1985.** O'Hop, J.R.; Tilly, L.J.; Chimney, M.J. (Environmental and Chemical Sciences, Inc., Aiken, SC (USA)). Jun 1986. Contract AC09-76SR00001. 314p. (ECS-SR—29). NTIS, PC A14/MF A01; 1; GPO Dep. File Number DE87013032.

This report presents data on: (1) the taxonomic composition, biomass, and density of macroinvertebrates that colonize artificial substrate samplers placed at designated locations in the Savannah River and tributary creeks on the SRP; (2) the taxonomic composition and densities of macroinvertebrates in the drift communities of the Savannah River and five tributary creeks that drain the SRP; (3) the biomass and chlorophyll a content of periphyton communities that colonize artificial substrates in the Savannah River and tributary creeks on the SRP; (4) water-quality data for selected parameters in the Savannah River and major tributary creeks upstream, downstream, and in the vicinity of the SRP; and (5) the possible impacts of the existing and proposed SRP thermal discharges on the macroinvertebrate and periphyton communities of the Savannah River and tributary creeks.

42033 **(PB—87-187399/XAB) Test of prototype reverse-osmosis energy-recovery device and correction of its deficiencies. Final report.** Pelmulder, J.P. (Polymetrics, Inc., San Jose, CA (USA)). Jul 1983. 57p. NTIS, PC A04/MF A01.

The objective of reducing the energy requirements of desalination has become increasingly important as the cost of energy has been rising in recent years. There are two basic methods for recovering the hydraulic energy: centrifugal devices, such as hydroturbine and pelton wheels, and positive displacement devices. A prototype energy-recovery device was refurbished and integrated with a reverse osmosis simulator for further testing. A valve test stand was also constructed and several valves were tested. During testing there were continuing reliability problems with the many valves in the system. It appears that the use of many separate components creates an excessively complicated system with too many potential failure points.

5206 Regulations

REFER ALSO TO CITATION(S) 41094, 41988, 41989, 41992, 41995, 41996, 42012

42034 **(PB—87-188082/XAB) Guidance on issuing permits to facilities required to analyze groundwater for Appendix 8 constituents. Final report, 1985-1986.** (Environmental Protection Agency, Washington, DC (USA). Office of Solid Waste). Feb 1986. 55p. NTIS, PC A04/MF A01.

The document is only a guide to the exercise of discretion under permit application regulations. It does not constrain discretion or require permit writers to follow its recommendation either generally or in any particular case. EPA intends it to provide interim relief to expedite permit issuance while the Agency pursues regulatory changes to the requirements for analyzing groundwater for

Appendix VIII constituents. The guidance addresses Appendix VIII only in the context of groundwater monitoring. It does not call into question the appropriateness of using Appendix VIII for other purposes, such as listing hazardous wastes or conducting corrective action for releases to any other environmental medium.

53 ENVIRONMENTAL-SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

REFER ALSO TO CITATION(S) 41120

5301 Social And Economic Studies

REFER ALSO TO CITATION(S) 41944, 42271

42035 **(NP—7770220) Regulation and innovation. A connection so far left unexplored empirically, to a large extent.** Maas, C. (Technische Univ. Berlin (Germany, F.R.). Wirtschaftswissenschaftliche Dokumentation). 1986. 49p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE87770220.

The lack of knowledge of the connection between regulation and innovation is due to the use of an unspecified ceteris-paribus clause, and to problems of measuring the innovative efficiency. The knowledge of positive innovation-impacts of regulations in the field of environmental protection is also relatively small. There are studies which indicate that regulations in ecologically intensive production industries forced the management to use nearly fully mature end-of-the-pipe techniques. Environmentally favourable changes of production processes on the other hand, primarily served the saving of fresh water, energy and raw materials. Environmentally favourable innovations, which are also classified as being economical, are however not adopted by all potential users. (orig./HSCH).

5302 Assessment Of Energy Technologies

REFER ALSO TO CITATION(S) 40421, 40422, 40423, 40424, 40425, 40437, 40438, 40439, 40440, 41988, 41989

55 BIOMEDICAL SCIENCES, BASIC STUDIES

REFER ALSO TO CITATION(S) 41583

42036 **(ZfI—64) Computer codes for problems of isotope and radiation research. Collection of computer codes developed by the Information and Computing Centre, Central Institute of Isotope and Radiation Research.** Remer, M. (ed.). (Akademie der Wissenschaften der DDR, Leipzig. Zentralinstitut fuer Isotopen- und Strahlenforschung). Dec 1986. 39p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87702867.

In FORTRAN, ASSEMBLER and PL/1 for ES 1040 computer.

A survey is given of computer codes for problems in isotope and radiation research. Altogether 44 codes are described as titles with abstracts. 17 of them are in the INIS scope and are processed individually. The subjects are indicated in the chapter headings: 1) analysis of tracer experiments, 2) spectrum calculations, 3) calculations of ion and electron trajectories, 4) evaluation of gamma irradiation plants, and 5) general software.

42037 (ZfI—64, pp 6) **INTENS - calculation of outlet probabilities by means of the intensity function and their graphical representation on DIGIGRAF plotter.** Frenzel, B. Dec 1986. NTIS (US Sales Only), PC A03/MF A01. File Number DE87702867.

In Computer codes for problems of isotope and radiation research.

42038 (ZfI—64, pp 6-7) **KORMES - correction of measured impulse rates with null effect, half-life period and sound factor, and graphical representation on a DIGIGRAF plotter.** Frenzel, B. Dec 1986. NTIS (US Sales Only), PC A03/MF A01. File Number DE87702867.

In Computer codes for problems of isotope and radiation research.

42039 (ZfI—64, pp 7) **MKQP3 - calculation of parameters of the protein metabolism.** Nickel, A. Dec 1986. NTIS (US Sales Only), PC A03/MF A01. File Number DE87702867.

In Computer codes for problems of isotope and radiation research.

42040 (ZfI—64, pp 8) **NILAR - a nonlinear least squares program package for compartmental models.** Winkler, E.; Wagner, B. Dec 1986. NTIS (US Sales Only), PC A03/MF A01. File Number DE87702867.

In Computer codes for problems of isotope and radiation research.

42041 (ZfI—64, pp 9) **ACTIV - a program package for automatic processing of gamma-ray and X-ray spectra by dialog by means of graphical colour display.** Zlokazov, V.B.; Riedel, F. (Joint Institute for Nuclear Research, Dubna, USSR). Dec 1986. NTIS (US Sales Only), PC A03/MF A01. File Number DE87702867.

In Computer codes for problems of isotope and radiation research.

42042 (ZfI—64, pp 10) **DIASPEK - an interactive program for the representation of spectral data by means of a graphical display.** Goerner, A. Dec 1986. NTIS (US Sales Only), PC A03/MF A01. File Number DE87702867.

In Computer codes for problems of isotope and radiation research.

5502 Biochemistry

REFER ALSO TO CITATION(S) 41507, 41536, 42048, 42276

42043 **(CONF-8706164—1) Biphasic response of Na^+-dependent amino acid transport to tumor promoting phorbol esters in cultured renal epithelial cells, LLC-PK1.** Dawson, W.D.; Cook, J.S. (Tennessee Univ., Oak Ridge (USA). Graduate School of Biomedical Sciences; Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012526.

From Symposium of biological transport group and midwest salt and water club joint meeting; Cumberland, KY, USA (21 Jun 1987).

Confluent cultures of LLC-PK1 pig kidney epithelial cells respond to tumor promoting phorbol esters and certain analogs of diacylglycerol with a 2-3 fold increase in Na^+-dependent amino acid transport via the A-system transporter. 12-O-tetra-decanoyl phorbol 13-acetate (TPA) activates the protein phosphorylating enzyme protein kinase C. That the A-system transporter also responds vigorously to TPA suggests that the A-system may be regulated in relation to growth control. We find that the transport increase requires 45 to 90 min to develop after exposure to TPA. If cells are transferred to an amino acid serum-free medium prior to exposure to TPA an additional rapid transient response is seen during which the A-system transport increases by 1.8 to 3 times in 5 to 7 min before returning to near control levels by 20 min. After 30 min or more of continued exposure to TPA the transport rate begins to rise in a manner similar to that seen in cells which have not been pre-incubated in the amino acid-serum-free medium. The rapid transient phase of the transport response correlates with an increase in TPA-stimulated membrane protein phosphorylation which is sensitive to the protein kinase C inhibitor sphingosine. The return of the transport rate to control levels can be delayed by inhibitors of phosphatase activity. The later phase of TPA-stimulated

A-system activity is associated with an increase in labeling of membrane proteins with [35S]methionine and is sensitive to cycloheximide. 7 refs., 6 figs.

42044 **(DOE/ER/12086—T3) [Viruses of eukaryotic green algae]: Performance report.** (Nebraska Univ., Lincoln (USA). Dept. of Plant Pathology). 1987. Contract AC02-82ER12086. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012651.

The primary objective of this research was to develop the Chlorella-PBCV-1 virus system so that it can be used as a model system for studying gene expression in a photosynthetic eukaryote. Discoveries include the finding that morphologically similar, plaque forming, dsDNA containing viruses are common in nature and can be isolated readily from fresh water; the finding that all of these Chlorella viruses contain methylated bases which range in concentration from 0.1% to 47.5% m^5dC and 0 to 37% m^6dA and the discovery that infection with at least some of these viruses induces the appearance of DNA modification/restriction systems. 18 refs.

42045 **Detection of calmodulin binding protein at 170 KDA in BALB, AKR, DON and chicken granulosa cells.** Selinfreund, R.; Lin, P.H.; Marrone, B.; Wharton, W. (Los Alamos National Lab., NM). *Federation Proceedings, Federation of American Societies for Experimental Biology;* **46**: No. 6, 2000(1 May 1987). (CONF-870644—).

From 78. annual meeting of the American Society of Biological Chemists conference; Philadelphia, PA, USA (7 Jun 1987).

Calmodulin (CAM) has been shown to bind to the epidermal growth factor (EGF) receptor (170 kDa) and is phosphorylated in a EGF dependent manner in the A431 human epidermoid carcinoma cells. In the present study, they report ^{125}I-CAM binding to a 170 kDa protein detected in cell membrane vesicles of Balb/3T3, AKR, DON and chicken granulosa cells. Purified plasma membranes from these cells were resolved via electrophoresis (without heat denaturation) and electroblotted onto nictrocellulose paper. Upon hybridizing against ^{125}I-CAM, a distinct autoradiographic band occurred at 170 kDa for all the cells lines under study. The binding of CAM is specific and can be displaced with the addition of excess unlabeled CAM. The result suggest that ^{125}I-CAM may bind to the 170 kDa EGF receptor in BALB, AKR, DON and chicken granulosa cells.

42046 **Mapping of phosphomonoester and apparent phosphodiester bonds of the oncogene product p53 from simian virus 40-transformed 3T3 cells.** Samad, A.; Anderson, C.W.; Carroll, R.B. (New York Univ. Medical School, NY). *Proceedings of the National Academy of Sciences of the United States of America;* **83**: No. 4, 897-901(Feb 1986).

The oncogene product p53, isolated from SV3T3 cells where it forms a complex with simian virus 40 large tumor antigen (T antigen) in the nucleus, has been found to be phosphorylated at least four distinct sites on the 390 amino acid protein. Separation of tryptic phosphopeptides has permitted identificatio of two sites as Ser-312 and Ser-389, and permitted analysis of the types of phosphate bonds. The peptide containing Ser-312 separates electrophoretically into three charged forms; two are resistant to dephosphorylation by both alkaline phosphatase and alkaline hydrolysis, suggesting a phosphodiester. The carboxyl-terminal phosphopeptide containing Ser-389 was alkaline phosphatase-resistant and liberated four ribonucleoside monophosphates upon base or RNase hydrolysis, suggesting that Ser-389 may be covalently linked to RNA. Phosphorylation of Ser-389 decreased markedly at the nonpermissive temperature in simian virus 40 tsA58-transformed cells, indicating a dependence on native T antigen function and a possible role in transformation by T antigen. Two additional phosphorylation sites, one involving serine and one involving threonine, probably reside in the amino-terminal segment of p53 and appear to be peptide-phosphate monoesters.

42047 **Natural populations of Trypanosoma cruzi, the agent of Chagas disease, have a complex multiclonal structure.** Tibayrenc, M.; Ward, P.; Moya, A.; Ayala, F.J. (Univ. of California, Davis). *Proceedings of the National Academy of Sciences of the United States of America;* **83**: No. 1, 115-119(Jan 1986).

The authors have studied 15 gene loci coding for enzymes in 121 Trypanosoma cruzi stocks from a wide geographic range - from the US and Mexico to Chile and southern Brazil. T.cruzi is diploid but reproduction is basically clonal, with very little if any sexuality remaining at present. They have identified 43 different clones by their genetic composition; the same genetic clone is often found in very distant places and in diverse hosts. There is much genetic heterogeneity among the different clones, and they cannot be readily classified into a few discrete groups that might represent natural taxa. These findings imply that the biological and medical characteristics need to be ascertained separately for each natural clone. The evidence indicates that clonal evolution is very ancient in T.cruzi. The authors propose two alternative hypotheses concerning the relationship between the biochemical diversity and the heterogeneity in other biological and medical characteristics of T. cruzi. One hypothesis is that the degree of diversity between strains simply reflects the time elapsed since their last common ancestor. The second hypothesis is that biological and medical heterogeneity is recent and reflects adaptation to different transmission cycles. A decision between the two hypotheses can be reached with appropriate studies, with important medical consequences.

5503 Cytology

42048 **(UCRL—96858) Flow cytometric analysis and sorting of chromosomes.** Van Dilla, M.A.; Dean, P.N.; Fuscoe, J.C.; Gray, J.W.; Lucas, J.N.; Peters, D.C.; Trask, B.J.; van den Engh, G.J. (Lawrence Livermore National Lab., CA (USA)). 24 Jun 1987. Contract W-7405-ENG-48. 31p. (CONF-8703142—2). NTIS, PC A03. File Number DE87012241.

From New trends in genetic risk assessment meeting; Nice, France (9 Mar 1987).

For analysis by flow cytometry, metaphase chromosomes are isolated from mitotic cells, and then stained while in suspension with one or more usually two, DNA-specific fluorescent dyes. The chromosomes are then processed one at a time through a flow cytometer or sorter where their dye content is measured at high speed and with high precision. In the work described here, dual staining is used since bivariate analysis affords better discrimination among chromosomal types: two dyes commonly used are Hoechst 33258, which binds preferentially to AT-rich DNA, and chromomycin A3, which bind preferentially to GC-rich DNA. For bivariate flow studies the chromosomes pass sequentially through 2 laser beams; the wavelength of one laser beam is adjusted to match the absorption maximum of one dye, and the wavelength of the other laser beam is adjusted to match the absorption maximum of the other dye. Thus each chromosome emits two fluorescent signals which give information on its DNA content and base composition. In typical measurements lasting a few minutes, about 10^5 chromosomes are analyzed. The bivariate fluorescence distribution accumulated by the electric processing units contains quantitative information about the chromosome population in the form of peaks produced by one or more chromosomal types. This distribution is called a flow karyotype, in analogy to the standard karyotype obtained by the cytogeneticist via banding techniques. In a flow sorter, the two fluorescent signals generated by each chromosome are used to trigger sorting of specific chromosomal types. This report reviews the current work in this area at Lawrence Livermore National Laboratory, including the work on the detection of chromosomal aberrations and on chromosome purification by sorting. 28 refs., 9 figs., 1 tab.

42049 **Effects of cholera toxin and isobutylmethylxanthine on growth of human fibroblasts.** Espinoza, B.; Wharton, W. (Los Alamos National Lab., NM). *American Journal of Physiology;* **251**: No. 2, C238-C246(Aug 1986). Contract W-7405-ENG-36.

Cholera toxin produced a dose-dependent decrease in the restimulation of G_0/G_1 traverse in density-arrested human fibroblasts but did not inhibit the stimulation of cells arrested in G_0 after serum starvation at low density. In addition, cholera toxin did not inhibit the proliferation of sparse logarithmically growing human fibroblasts, even when low concentrations of the phosphodiesterase inhibitor isobutylmethylxanthine (IBMX) were also present. How-

ever, the final density to which sparse cells grew was limited by cholera toxin, when added either alone or together with low concentrations of IBMX. In contrast, high concentrations of the phosphodiesterase inhibitor alone produced a profound inhibition in the growth of sparse human fibrobasts. IBMX produced an inhibition both in the G_1 and in the G_2 phases of the cell cycle by a mechanism(s) that was not related to the magnitude of the increases in adenosine 3,5-cyclic monophosphate concentrations.

42050 **Location of the chloride self-inhibitory site of the human erythrocyte anion exchange system.** Knauf, P.A.; Mann, N.A. (Univ. of Rochester, NY). *American Journal of Physiology;* **251**: No. 1, C1-C9(Jul 1986). Contract AC02-76EV03490.

Experiments were performed with intact human red blood cells to determine whether the inhibitory effects of high Cl^- concentrations of Cl^- exchange are primarily due to interaction at the cytoplasmic or the external surface of the membrane. When internal Cl^- was varied from 150 mM to 600 mM Cl^- keeping external Cl^- constant at 150 mM Cl^- exchange was inhibited almost exactly as much as when both internal and external Cl^- were increased from 150 mM to 600 mM. On the other hand, if internal Cl^- was maintained constant at 600 mM, variation of external Cl^- had no consistent effect on Cl^- exchange. Even if internal Cl^- was kept at 150 mM by substitution of gluconate for Cl^-, an increase in external Cl^- from 150 mM to 600 mM did not significantly inhibit Cl^- exchange. Thus the self-inhibitory effects of Cl^- seem to be caused primarily by binding to a site at the cytoplasmic side of the membrane. External Br^-, on the other hand, did cause a significant inhibition of Cl^- exchange. In contrast to the inhibitory effects of Cl^- at neutral pH, at very high pH (around pH 11) there is an activation of Cl^- exchange at very high Cl^- concentrations. This effect, however, depends on binding of Cl^- to an external site. Thus there seem to be at least two different low-affinity Cl^- binding sites, one at the cytoplasmic side, which inhibits Cl^- exchange, and one at the external side, which activates Cl^- exchange at high external pH.

5504 Genetics

REFER ALSO TO CITATION(S) 41271, 42048

42051 **Spatial organization of the small ribosomal subunit of E. coli.** Moore, P.B.; Capel, M.; Kjeldgaard, M.; Engelman, D.M. (Yale Univ., New Haven, CT). *Federation Proceedings, Federation of American Societies for Experimental Biology;* **46**: No. 6, 2052(1 May 1987). (CONF-870644—).

From 78. annual meeting of the American Society of Biological Chemists conference; Philadelphia, PA, USA (7 Jun 1987).

The positions of all 21 proteins in the 30S ribosomal subunit of E. coli have been determined by neutron scattering methods. Since the sites where these proteins bind to 16S rRNA are becoming known with increasing precision, the protein map for the particle is a valuable source of information about the tertiary structure of the RNA. The relationship between the structure of the intact particle and its assembly in vitro will be demonstrated, and correlations between the structure of the particle and its function in protein synthesis discussed.

42052 **Quantitative genetic analysis of morphological variation in an antarctic diatom grown at two light intensities.** Wood, A.M.; Lande, R.; Fryxell, G.A. (Univ. of Chicago, IL). *Journal of Phycology;* **23**: No. 1, 42-54(Mar 1987). Contract AC02-81ER60014.

Ten clonal isolates of Thalassiosira tumida (Janisch) Hasle were grown in duplicate semi-continuous batch cultures at 116 and 11.6 $\mu E \times m^{-2} \times s^{-1}$; acclimated cells were harvested during exponential growth and cleaned for examination by light microscopy (LM) and scanning electron microscopy (SEM). Number of strutted processes surrounding the central annulus (SP) and average number of satellite pores per process (AVSAT) were counted using SEM on 20 valves from each culture grown in high light, for a total of 400 valves examined; number of marginal labiate processes (LP) and overall diameter (DIAM) were measured using LM on 20 valves form each culture grown in both high and low light for a total of 800 valves examined. Univariate analysis of variance showed that bottle effects resulting from microenvironmental differences between replicates were a small but significant source of variation in DIAM, LP, and SP but not AVSAT. Significant differences among clones were observed for all characters. Decreased irradiance resulted in a significant decrease in valve diameter but no significant effect on LP; no light x clone interaction was observed. Analysis of the size-corrected data showed that the proportion of total phenotypic variance in SP; LP, and AVSAT caused by genetic differences among clones was 0.14, 0.14, and 0.30, respectively. This indicates that the majority of total phenotypic variance was due to environmental or developmental causes, but that sufficient genetic variability exists to support rapid phenotypic evolution in SP, LP, and AVSAT under continued directional section. Finally, the results of the genetic analysis revealed a high (0.82) genetic correlation between SP and LP.

5505 Metabolism

REFER ALSO TO CITATION(S) 40695, 41947, 41998, 41999, 42183, 42263, 42264, 42265, 42266, 42279, 42281

42053 (IAEA-TECDOC—406, pp 37-43) **Study of lindane in laying hens.** Begovic, J.; Rusov, C.; Zivkovic, R.; Vojinovic, V. (Institute for the Application of Nuclear Energy in Agriculture, Veterinary Medicine and Forestry, Zemun, Yugoslavia. Dept. of Physiology and Radiobiology; Institute for the Application of Nuclear Energy in Agriculture, Veterinary Medicine and Forestry, Zemun, Yugoslavia. Dept. of Pesticides). Jan 1987. NTIS (US Sales Only), PC A05/MF A01. File Number DE87702735. (CONF-8607333—Summ.).

From Research co-ordination meeting on studies of agricultural chemical residues in meat, milk and related products of livestock with the aid of nuclear techniques; Belgrade, Yugoslavia (16 Jul 1986).

Dynamics of lindane (gamma-hexachlorocyclohexane) distribution and elimination were studied in laying hens of SSL breed receiving orally either a single dose of 20 mg/kg body weight or via feed at 0.5, 5.0 and 20.0 mg/kg body weight for 30 consecutive days. The results showed that consumption of lindane did not affect the general health of the animals, production or quality of eggs. Gas chromatography showed that lindane was distributed in various organs and accumulated at detectable levels in liver, brain, fatty tissue and muscles. Significant amounts of lindane residues were found in eggs and could be detected for 60 days. A major portion of lindane was eliminated through faeces in the first 10 days after administration. The presence of significant amounts of lindane residues in eggs is particularly important due to their role in chicken reproduction and human nutrition. 12 refs, 3 figs, 2 tabs.

42054 (IAEA-TECDOC—406, pp 45-50) **Study of the fate of /sup 14/C-lindane in laying hens.** Begovic, J.; Rusov, C.; Zivkovic, R. (Institute for the Application of Nuclear Energy in Agriculture, Veterinary Medicine and Forestry, Zemun, Yugoslavia. Dept. of Physiology and Radiobiology). Jan 1987. NTIS (US Sales Only), PC A05/MF A01. File Number DE87702735. (CONF-8607333—Summ.).

From Research co-ordination meeting on studies of agricultural chemical residues in meat, milk and related products of livestock with the aid of nuclear techniques; Belgrade, Yugoslavia (16 Jul 1986).

The distribution and elimination of /sup 14/C-lindane (gamma-hexachlorocyclohexane) were studied in laying hens. /sup 14/C-lindane was administered orally at 0.78 μCi/5 μg per hen daily for 30 consecutive days. Animals were then sacrificed at determined time intervals. Radiocarbon was detected in the muscles, liver, fat, brain and ovary as well as in eggs and faeces. The highest radioactivity in tissues and organs was detected one day after the last dose was administered. Residues were particularly high in fat (0.164 μg/g). The radioactivity in the egg-yolk increased gradually reaching a peak on the 26th day (0.102 μg/g) and then began to decline slowly. After 90 days, radiocarbon was still detectable in the egg-yolk. A considerable amount of labelled lindane residues was eliminated via faeces. The studies conducted with radioactive lindane have shown that the application of nuclear techniques has

provided a very sensitive, accurate and simple method for residue analysis. 12 refs, 3 figs.

42055 (IAEA-TECDOC—406, pp 51-55) **Fate of /sup 14/C-deltamethrin in lactating dairy cows.** Akhtar, M.H.; Hartin, K.E.; Trenholm, H.L. (Agriculture Canada, Ottawa, Ontario. Animal Research Centre). Jan 1987. NTIS (US Sales Only), PC A05/MF A01. File Number DE87702735. (CONF-8607333—Summ.).

From Research co-ordination meeting on studies of agricultural chemical residues in meat, milk and related products of livestock with the aid of nuclear techniques; Belgrade, Yugoslavia (16 Jul 1986).

Fate and residues of radiocarbon (/sup 14/C) labelled (gem-dimethyl or benzyl) deltamethrin were determined in lactating cows after oral administration for three consecutive days and slaughtering the animals 24 hr after the last dose. Orally administered deltamethrin (10 mg/kg of body weight) appeared to be poorly absorbed, but the insecticide which was absorbed was extensively metabolized and excreted in the bile and urine with very little accumulation in major edible tissues. Approximately 36-43% of the total administered radiocarbon was eliminated in feces mostly as deltamethrin within 24 hr after the last dose. Only 4-6% of the administered /sup 14/C was eliminated in urine; and 0.42-1.62% was secreted in the milk. Radiocarbon secreted into milk was higher for the gem-dimethyl portion (0.69 μg/g) than from the benzyl moiety (0.36 μg/g); deltamethrin was the major product in milk (0.1-0.14 μg/g). Radiocarbon residues in tissues were low (<0.1 μg/g), except liver and kidney (1.28-3.19 μg/g), abdominal and subcutaneous fat (0.28-0.62 μg/g). 1 fig.

42056 (IAEA-TECDOC—406, pp 57-60) **Metabolism, distribution, and excretion of deltamethrin by leghorn hens.** Akhtar, M.H.; Hamilton, R.M.G.; Trenholm, H.L. (Agriculture Canada, Ottawa, Ontario. Animal Research Centre). Jan 1987. NTIS (US Sales Only), PC A05/MF A01. File Number DE87702735. (CONF-8607333—Summ.).

From Research co-ordination meeting on studies of agricultural chemical residues in meat, milk and related products of livestock with the aid of nuclear techniques; Belgrade, Yugoslavia (16 Jul 1986).

Leghorn hens were administered orally 7.5 mg of /sup 14/C-labelled (gem-dimethyl or benzyl) deltamethrin per hen per day for three consecutive days, and the elimination of /sup 14/C in excreta and eggs was monitored for five days after the last dose. Approximately 83% of the administered /sup 14/C was eliminated within 24h after initial dosing. Tissue residues were generally very low with the exception for those for liver and kidney. Egg yolks contained considerably higher levels of residues than egg albumen. A large number of metabolites were isolated and identified by high resolution mass spectrometry technique. The metabolite identified indicated that the metabolic routes of deltamethrin in laying hens include hydrolysis of ester linkage, followed by hydroxylation of one or both gem-dimethyl groups, hydroxylation of 2'-,4'-,5-, or 6 position of the phenoxylbenzyl moiety. 1 fig.

42057 (IAEA-TECDOC—406, pp 61) **Behaviour of /sup 14/C-niclosamide in aquatic systems.** El-Hindi, A.M. (Ministry of Health, Khartoum, Sudan. National Chemical Labs.). Jan 1987. NTIS (US Sales Only), PC A05/MF A01. File Number DE87702735. (CONF-8607333—Summ.).

From Research co-ordination meeting on studies of agricultural chemical residues in meat, milk and related products of livestock with the aid of nuclear techniques; Belgrade, Yugoslavia (16 Jul 1986).

42058 (IAEA-TECDOC—406, pp 63-69) **Niclosamide residues in milk and tissues of lactating goats.** El-Hindi, A.M.; Sidra, M.S. (Ministry of Health, Khartoum, Sudan. National Chemical Labs.). Jan 1987. NTIS (US Sales Only), PC A05/MF A01. File Number DE87702735. (CONF-8607333—Summ.).

From Research co-ordination meeting on studies of agricultural chemical residues in meat, milk and related products of livestock with the aid of nuclear techniques; Belgrade, Yugoslavia (16 Jul 1986).

Radiocarbon labeled niclosamide was orally administered to two groups of lactating goats at levels equivalent to about 2 ppm in drinking water for five consecutive days, and at levels equivalent to about 10 ppm in drinking water (1-day basis) as a single dose. Residues of the molluscicide in milk did not exceed 0.001 ppm at any time. About 50% of the administered radioactivity was eliminated in faeces, while about 30% was excreted through urine in treated animals within 6 days after final dosing. TLC analysis revealed the presence of two unidentified niclosamide metabolites. The unchanged molluscicide was present only in trace amounts. Highest radiocarbon residues in tissues of the treated goats occurred in the liver (0.01-0.04 ppm niclosamide equivalent). From these data, it was concluded that absorbed niclosamide is almost completely metabolized and rapidly eliminated through urine of goats. Little or no residues were detected in lean muscles and milk which are consumed by humans. There was no significant deposition of the molluscicide or its metabolites in fat. 6 refs, 5 tabs.

42059 (IAEA-TECDOC—406, pp 71-81) **Fate and residues of pesticides and other agriculturally significant chemicals in livestock and poultry as determined by radiotracer techniques.** Ivie, G.W. (Agricultural Research Service, College Station, TX, USA). Jan 1987. NTIS (US Sales Only), PC A05/MF A01. File Number DE87702735. (CONF-8607333—Summ.).

From Research co-ordination meeting on studies of agricultural chemical residues in meat, milk and related products of livestock with the aid of nuclear techniques; Belgrade, Yugoslavia (16 Jul 1986).

Studies in the author's laboratories during this 5-year program have involved the use of radioisotope techniques (radiocarbon, tritium) to evaluate the fate of several agriculturally-significant chemicals in food animals. Included were studies of the fate of radiolabeled preparations of the organophosphorus insecticide, RH-0994, in a lactating cow; of the organophosphorus insecticide, coumaphos, after dermal application to goats as a pour on formulation; of the synthetic pyrethroid insecticide, resmethrin, in lactating cattle and laying hens; of the growth promoting drug, β-estradiol, after intramuscular injection into steer calves; of the environmental contaminants 4-chlorophenyl methyl sulfide and -sulfone in cattle and sheep; of the potent photosensitizer, xanthotoxin, in a goat, in bovine rumen fluid, and in laying hens; and of the trichothecene mycotoxin, T-2 toxin, in bovine rumen fluid. In these studies, particular emphasis was placed upon elucidation of the chemical nature of metabolic products generated, and upon quantification as appropriate of residues retained by edible tissues or secreted into milk or eggs. 11 refs, 15 figs, 1 tab.

42060 (IAEA-TECDOC—406, pp 83) **Metabolism of /sup 14/C-sulfamethazine in swine and rats.** Paulson, G. (Agricultural Research Service, College Station, TX, USA). Jan 1987. NTIS (US Sales Only), PC A05/MF A01. File Number DE87702735. (CONF-8607333—Summ.).

From Research co-ordination meeting on studies of agricultural chemical residues in meat, milk and related products of livestock with the aid of nuclear techniques; Belgrade, Yugoslavia (16 Jul 1986).

5506 Medicine

REFER ALSO TO CITATION(S) 40674, 41635, 41741, 42222, 42228, 42231, 42232, 42233, 42238, 42269, 42636

42061 **(CEA-CONF—8740) In vivo study of central receptors in man using pet.** Baron, J.C. (CEA, 91 - Orsay (France). Service Hospitalier Frederic Joliot). Sep 1986. 10p. (CONF-8609280—1). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752261.

From Congress of European Society for Neurochemistry; Prague, Czechoslovakia (1 Sep 1986).

Central neurotransmitter systems and receptors are intimately involved in the mechanism of several neurologic and phychiatric disorders. Although neurotransmitter concentration and receptor function can be measured regionnally post-mortem, studies performed during life may provide insight into changes at early stages

of the disease as well as follow-up data on, and pharmacological modification of, such changes. Positron Tomography (PET) allows to monitor non-invasively the time-course of regional tissue tracer concentration following administration of a radioactive drug. If the latter is known to interact selectively with specific binding sites, it can be used to probe in vivo the regional distribution and affinity of the receptors involved. As shown in this progress report, several receptor systems can now be studied reliably in humans, using PET.

42062 **(CEA-CONF—8750) Processing and display of three-dimensional arrays of numerical data using Octree encoding.** Amans, J.L.; Antoine, M.; Darier, P. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI)). Apr 1986. 9p. (In French). (CONF-8604321—1). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752255.

From 2. image symposium: international electronic image week; Nice, France (21 Apr 1986).

The analysis of three-dimensional (3-D) arrays of numerical data from medical, industrial or scientific imaging, by synthetic generation of realistic images, has been widely developed. The Octree encoding, that organizes the volume data in a hierarchical tree structure, has some interesting features for 3-D arrays of data processing. The Octree encoding method, based on the recursive subdivision of a 3-D array, is an extension of the Quadtree encoding in the two-dimensional plane. We have developed a software package to validate the basic Octree encoding methodology for some manipulation and display operations of volume data. The contribution introduces the technique we have used (called "overlay technique") to make the projection operation of an Octree on a Quadtree encoded image plane. The application of this technique to the hidden surface display is presented.

42063 **(CEA-CONF—8751) Voludensitometry: optimization of the computation of the 3D Radon Transform from the cone-beam X-ray radiographies.** Grangeat, P. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI)). Apr 1986. 6p. (In French). (CONF-8604321—2). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752256.

From 2. image symposium: international electronic image week; Nice, France (21 Apr 1986).

The aim of the voludensitometry is to reconstruct the material density function all among a three-dimensional area of interest from a set of digital radiographies acquired all around the object or the patient. We study the case where the X-ray source describes a circular trajectory centred on the object. The cone-beam geometry of the rays prevents to decompose the inverse problem in a superposition of two-dimensional reconstructions. We use the 3D Radon Transform and its inversion formula to implement a direct reconstruction algorithm. We describe here a powerful method to compute an approximation of the 3D Radon Transform. We state in particular, how it is possible to use the reprojection algorithm defined by P.M. Joseph.

42064 **(DOE/ER/60203—T2) Experimental investigation with radiolabeled anti-collagen antibodies and related antibodies: Final technical progress report.** Gottschalk, A. (Yale Univ., New Haven, CT (USA). School of Medicine). Jul 1987. Contract AC02-84ER60203. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013689.

Progress on development of a labelled anti-collagen antibody to use as a scintigraphic tracer for localizing trauma is described. Several potential animal models for studying injury were developed. (DT)

42065 **(DOE/EV/02031—17) Radiopharmaceuticals for diagnosis and treatment: Progress report for the period November 1, 1968 through July 1, 1987.** Kuhl, D.E. (Michigan Univ., Ann Arbor (USA). Div. of Nuclear Medicine). Jul 1987. Contract AC02-76EV02031. 62p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87013088.

This project has been directed to the evolution of labeled chemicals useful for nuclear medical imaging to trace adrenal functions and localizing tumors in the neuroendocrine system. A major success was the introduction of ^{131}I-metaiodobenzylguanidine (MIBG). The uptake of radiolabeled precursors of epinephrine was explored. The uptake and excretion of five C-14 labeled precursors of epinephrine was studied in dogs. The adrenal medulla uptake of C-14 dopamine exceeded that of all other precursors. During the initial attempts to synthesize a successful adrenal medulla imaging agent, the concentration of C-14 dopamine in the human neuroblastoma was found to be considerably greater than in the normal human adrenal medulla. Radioiodinated bretylium analog was prepared that images the dog adrenal medulla. This effort was rapidly followed by the synthesis of original compounds with structural similarities to both norepinephrine and the adrenergic neuronal blocking agent, guanethidine; these latter agents demonstrating greater adrenal medulla specificity than the bretylium analogs. One of these guanidine derivatives, ^{131}I-metaiodobenzylguanidine (MIBG) has permitted the first successful diagnostic imaging of human adrenal medullary hyperplasia and of pheochromocytomas (including metastasized carcinoma) which could not be localized by any existing methodologies.

42066 (INIS-BR—651, pp 17) **Radioisotopic exploration in diagnosis of repetition pneumopathy by gastro esophageal reflex.** Gabbay, S.; Maliska, C.M.; Meguerian, B.A.; Coelho, V.H.P.; Barros, D.S.; Erthal, L.A.; Silva, N.C. da. 1985. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702483. (CONF-8511286—).

From 7. Brazilian meeting on nuclear medicine; Rio de Janeiro, RJ, Brazil (7 Nov 1985).

42067 (INIS-mf—10916, pp 792) **Effect of radiolabelling on the behaviour of antibodies.** Janoki, Gy.A.; Koeroesi, L.; Mohari, K.; Klivenyi, G.; Spett, B. (Orszagos Frederic Joliot-Curie Sugarbiologiai es Sugaregeszseguegyi Kutato Intezet, Budapest, Hungary). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

From 14. international cancer congress; Budapest, Hungary (21 Aug 1986).

42068 (INIS-mf—10916, pp 792) **Radiolabelling of antibodies used for diagnostic purposes.** Wolf, W.; Shani, J.; Shaharuddin, M. (Univ. of Southern California, Los Angeles). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

From 14. international cancer congress; Budapest, Hungary (21 Aug 1986).

42069 (INIS-mf—10916, pp 1141) **Scaling theory of transient nonlinear fluctuations in cancer radiotherapy.** Bhattacharyya, B.D. (Saint Xavier's College, Calcutta, India). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

From 14. international cancer congress; Budapest, Hungary (21 Aug 1986).

42070 (INIS-mf—10916, pp 561) **Increased tumor cure of murine tumors by the combined radiotherapy and Lonidamine.** Alfieri, A.A.; Kim, S.H.; Young, C.W.; Silvestrini, B. (Memorial Sloan-Kettering Cancer Center, New York, NY). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

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42131 (INIS-mf—10916, pp 764) **Radiobiological and clinical aspects of the high dose therapy in collum and corpus carcinoma.** Rattka, P. (Instytut Onkologii, Gliwice, Poland). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

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42132 (INIS-mf—10916, pp 764) **Intracavitary neutron therapy in oncogynecology.** Spasokukotskaya, O.N.; Ryaboukhin, Yu.S.; Chekhonadskij, V.N.; Marjina, L.A.; Tolokonov, B.O.; Lebedev, A.I. (All-Union Cancer Research Center, Moscow, USSR). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

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42133 (INIS-mf—10916, pp 812) **Low dose-rate irradiation on human cervical carcinoma xenotransplants: cell kinetic effects.** van Oostrum, I.E.A.; van Wijhe, M.H.; Rutgers, D.H. (Utrecht Univ., Netherlands). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

From 14. international cancer congress; Budapest, Hungary (21 Aug 1986).

42134 (INIS-mf—10916, pp 813) **Spontaneous chemoluminescence of blood serum in the assessment of effectiveness of radiation treatment of malignant neoplasms.** Baraboj, V.A.; Orel, V.E. (Nauchno-Issledovatel'skij Rentgeno-Radiologicheskij i Onkologicheskij Inst., Kiev, Ukrainian SSR). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

From 14. international cancer congress; Budapest, Hungary (21 Aug 1986).

42135 (INIS-mf—10916, pp 829) **CT-based three-dimensional treatment planning.** Schlegel, W. (Deutsches Krebsforschungszentrum, Heidelberg, Germany, F.R.). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

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42136 (INIS-mf—10916, pp 830) **Brachytherapy in Cracow.** Szymczyk, W.; Lesiak, J. (Centre of Oncology, Krakow, Poland). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

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42137 (INIS-mf—10916, pp 830) **Computerized body tomography in planning of radiation treatment of breast carcinoma.** Basic, H.; Musanovic, M.; Strinic, S.; Drljevic, A. (Sarajevo Univ., Yugoslavia). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

From 14. international cancer congress; Budapest, Hungary (21 Aug 1986).

42138 (INIS-mf—10916, pp 844) **Clinical results of hyperthermia combined with radiation in the treatment of cervical node metastatic cancer: analysis of 50 cases.** Li Qisiang; Tan Weiyi; Zhang Yushu; Ma Sulan. (Beijing Friendship Hospital, China). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

From 14. international cancer congress; Budapest, Hungary (21 Aug 1986).

42139 (INIS-mf—10916, pp 845) **Clinical study of hyperthermia in cancer radiotherapy.** Onoyama, Y.; Nakajima, T.; Kida, A.; Tanaka, M. (Osaka City Univ., Japan). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

From 14. international cancer congress; Budapest, Hungary (21 Aug 1986).

42140 (INIS-mf—10916, pp 1014) **Value of CT examination for the cancer control during and after radiotherapy and chemotherapy.** Riessbeck, K.H. (Humboldt-Universitaet, Berlin, German Democratic Republic). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

From 14. international cancer congress; Budapest, Hungary (21 Aug 1986).

42141 (INIS-mf—10916, pp 1014) **Investigation program for intraoperative radiotherapy.** Hoekstra, H.J.; Mehta, D.M.; Terpstra, S.; Oldhoff, J.; Bakker, D.; Crommelin, M. (Rijksuniversiteit Groningen, Netherlands; Catharina Hospital, Eindhoven, Netherlands). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

From 14. international cancer congress; Budapest, Hungary (21 Aug 1986).

42142 (INIS-mf—10916, pp 1015) **Quality assurance problems of the brain irradiation. Physical aspects.** Katona, E.; Weisz, C.; Polgar, I.; Zarand, P.; Nemeth, G. (Weil Emil Korhaz-Rendeloeintezet, Budapest, Hungary). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

From 14. international cancer congress; Budapest, Hungary (21 Aug 1986).

42143 (INIS-mf—10916, pp 1015) **Radiation therapy of nonoperable esophagus cancer by method of fractional therapy.** Abdrakhmanov, J.N.; Balmukhanov, S.B.; Revesz, L. (Kazakhskij Nauchno-Issledovatel'skij Institute Onkologii i Radiologii, Alma-Ata, USSR; Karolinska Institute, Stockholm, Sweden). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

From 14. international cancer congress; Budapest, Hungary (21 Aug 1986).

42144 (INIS-mf—10916, pp 1015) **Comparison of the results of different methods of fractionation in the radiotherapy of brain metastases.** Pamucka, M.; Kosniewski, W. (Regional Hospital of Oncology, Opole, Poland). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

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42145 (INIS-mf—10916, pp 1015) **Irradiation of multiple skin-metastases of malignant melanomas following the synchronizing of the cell division.** Szabo, P. (Josa Andras Hospital, Nyiregyhaza, Hungary). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

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42146 (INIS-mf—10916, pp 1016) **High dose fractionation in the radiotherapy of melanoma: clinical results.** Bauer, J.; Prokes, K.; Petruzelka, L. 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

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42147 (INIS-mf—10916, pp 1016) **High-dose-fraction radiation therapy for advanced malignant melanoma.** Meder, J.; Fijuth, J.; Danczak-Ginalska, Z. (Marie Sklodowska-Curie Memorial Institute, Warsaw, Poland). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

From 14. international cancer congress; Budapest, Hungary (21 Aug 1986).

42148 (INIS-mf—10916, pp 1016) **Desmoid tumors: response to irradiation and some clinical considerations.** Bujko, K.; Prejbisz, J. (Marie Sklodowska-Curie Memorial Institute, Warsaw, Poland). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

From 14. international cancer congress; Budapest, Hungary (21 Aug 1986).

42149 (INIS-mf—10916, pp 1017) **Problems of time dose relationship in radiotherapy of skin cancer.** Kuhelj, J.; Habic, M. (Ljubljana Univ., Yugoslavia). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

From 14. international cancer congress; Budapest, Hungary (21 Aug 1986).

42150 (INIS-mf—10916, pp 1018) **External radiation therapy of cancer of the prostate: 281 patients 1968-1981.** Vaeth, J.M.; Rounsaville, M.C. (Saint Mary's Hospital and Medical Center, San Fransisco, CA). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

From 14. international cancer congress; Budapest, Hungary (21 Aug 1986).

42151 (INIS-mf—10916, pp 1019) **Evaluation of different preoperative treatments in urinary bladder cancer.** Salminen, E.; Porkka, L.; Holsti, L.R.; Alfthan, O.; Maekinen, J.; Pyrhoenen, S. (Helsinki Univ. Central Hospital, Finland). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

From 14. international cancer congress; Budapest, Hungary (21 Aug 1986).

42152 (INIS-mf—10916, pp 1019) **Bladder cancer in New South Wales 1977-1982. Results of radiotherapy with or without cystectomy.** Mameghan, H.; Fisher, R. (Prince of Wales Hospital, Randwick, Australia). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

From 14. international cancer congress; Budapest, Hungary (21 Aug 1986).

42153 (INIS-mf—10916, pp 1020) **Techniques and results of postoperative radiotherapy at clear cell kidney cancer.** Patonay, P.; Weisz, Cs.; Nagykalnai, T.; Nemeth, Gy. (Weil Emil Korhaz-Rendeloeintezet, Budapest, Hungary). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

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42154 (INIS-mf—10916, pp 1020) **Radiation therapy of testicular tumors by 28-MeV betatron x-rays.** Gyarmathy, L.; Horvath, A.; Petranyi, J.; Reischl, G. (Orszagos Onkologiai Intezet, Budapest, Hungary). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

From 14. international cancer congress; Budapest, Hungary (21 Aug 1986).

42155 (INIS-mf—10916, pp 1020) **Preoperative radiotherapy on malignant brain tumors.** Kondo, T.; Yoshioka, M.; Muraoka, I.; Tsukamoto, Y.; Mikuriya, S.; Fujii, K.; Takakura, K. (National Medical Center of Hospital, Tokyo, Japan; Tokyo Univ., Japan). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

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42156 (INIS-mf—10916, pp 1020) **Cesium-137 seeds in brachytherapy of unresectable primary tumors of brain.** Lin Fangjen; Tsang Nganming; Heimburger, Robert. (Chang Gung Memorial Hospital, Taipei, TW, China). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

From 14. international cancer congress; Budapest, Hungary (21 Aug 1986).

42157 (INIS-mf—10916, pp 1021) **Results of Cf-252 brain neutron brachytherapy and photon beam teletherapy in the treatment of malignant gliomas (glioblastoma multiforme).** Chin, H.W.; Maruyama, Y. (Kentucky Univ., Lexington). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

From 14. international cancer congress; Budapest, Hungary (21 Aug 1986).

42158 (INIS-mf—10916, pp 1021) **Medulloblastoma. Survival after radiotherapy.** Wang, M.; Hatlevoll, R. (Norske Radiumhospital, Oslo). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

From 14. international cancer congress; Budapest, Hungary (21 Aug 1986).

42159 (INIS-mf—10916, pp 1118) **Clinical evaluation of combined use of radiation therapy and hyperthermia - on the basis of joint research in Japan.** Matsuda, T. (Tokyo Metropolitan Komagome Hospital, Japan). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

From 14. international cancer congress; Budapest, Hungary (21 Aug 1986).

42160 (INIS-mf—10916, pp 1143) **Alleviating action of OK-432 on the radiation-induced myelosuppression in mice and in medulloblastoma patients.** Aoki, Y. (National Institute of Radiological Sciences, Chiba, Japan). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

From 14. international cancer congress; Budapest, Hungary (21 Aug 1986).

42161 (INIS-mf—10916, pp 1276) **Randomized phase III study of chemotherapy/radiotherapy for small cell lung cancer.** Arnold, H.; Kraft, A.; Bodemann, H.; Zwingers, T.; Wannenmacher, M.; Hinkelbein, W.; Bueltzingsloewen, F. von; Freudenberg, N. (Freiburg Univ., Germany, F.R.). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

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42162 (INIS-mf—10916, pp 1277) **Treatment of superior vena cava syndrome.** Tagle, J.C.; Galvez, C.A.; Barg, S.; Trapani, C.A.; Temperley, G. (Hospital Municipal de Oncologia, Buenos Aires, Argentina). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

From 14. international cancer congress; Budapest, Hungary (21 Aug 1986).

42163 (INIS-mf—10916, pp 1277) **Treatment of non-small cell lung carcinoma with chemo-radiotherapy association: correlation between chemo and radio-sensibility.** Tourani, J.M.; Delaisements, C.; Marin, I. 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

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42164 (INIS-mf—10916, pp 1277) **Chemo-irradiation therapy for inoperable non-small cell lung cancer.** Khristov, I.; Krasteva, E.; Pandova, V.; Donchev, T.; Damjanov, D.; Khristova, S.; Timcheva, K. (Nauchno-Izsledovatelski Onkologichen Institute, Sofia, Bulgaria). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

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42165 (INIS-mf—10916, pp 1279) **Radiotherapy with cisplatinum potentation as neoadjuvant approach in 39 inoperable NSCLC. A pilot study.** Soresi, E.; Borghini, U.; Scoccia, S.; Leoni, M.; Botturi, M.; Clerici, M. (Niguarda Hospital, Milan, Italy; S.Carlo Borromeo Hospital, Milan, Italy). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

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42166 (INIS-mf—10916, pp 1279) **Systemic radiotherapy in inoperable small cell lung cancer.** Huettner, J.; Merkle, K.; Lessel, A.; Grunau, H. (Zentralinstitut fuer Krebsforschung, Berlin, Germany, F.R.). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

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42167 (INIS-mf—10916, pp 1280) **Non conventionally fractionated radiotherapy in patients with non small cell lung cancer.** Westlin, J.E.; Brodin, O.; Bergh, J.; Nilsson, S. (Uppsala Univ. Hospital, Sweden). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

From 14. international cancer congress; Budapest, Hungary (21 Aug 1986).

42168 (INIS-mf—10916, pp 1292) **Pre-operative irradiation of rectal carcinoma.** Schmidt, W.; Kiene, S.; Maskow, G. (Ernst-Moritz-Arndt-Universitaet, Greifswald, German Democratic Republic). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

From 14. international cancer congress; Budapest, Hungary (21 Aug 1986).

42169 (INIS-mf—10916, pp 1307) **Radiotherapy of esophageal tumors with intraluminal 137-Cs afterloading method.** Vigvary, Z.; Faller, J.; Kupcsulik, P.; Balazs, A. (Semmelweis Orvostudomanyi Egyetem, Budapest, Hungary). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

From 14. international cancer congress; Budapest, Hungary (21 Aug 1986).

42170 (INIS-mf—10916, pp 1018) **Brachytherapy of bladder cancer with intravesical radium source.** Gonzalez, M.O. (Anderson, M.D. Hospital and Tumor Institute, Houston, TX). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

From 14. international cancer congress; Budapest, Hungary (21 Aug 1986).

42171 **(INIS-mf—10933) Dose reduction by x-ray beam filtration in screen-film radiography. Experimental and theoretical aspects.** Koedooder, C. (Amsterdam Univ. (Netherlands)). 17 Sep 1986. 165p. NTIS (US Sales Only), PC A08/MF A01. File Number DE87702799.

This thesis describes experimental and theoretical aspects of dose reduction by x-ray beam filtration in screen-film radiography. The thesis deals mainly with dose reduction under the constraint of constant image quality; an analytical approach is chosen. Therefore, part of the thesis deals with the development of an algorithm to calculate patient dose and exposure for different filter materials and different tube load conditions, under the constraint of constant contrast and constant optical density.

42172 **(VROM-DSB—85-7) Inventory of X-ray apparatus in Dutch hospitals.** Timmermans, C.W.M.; Beentjes, L.B. (Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer, The Hague (Netherlands). Directie Stralenbescherming). Jul 1985. 35p. (In Dutch). (VROM—851010/12-85). NTIS (US Sales Only), PC A03/MF A01. File Number DE87702861.

The guideline of the European Communities concerning protection from radiation for persons which are subjected to medical diagnosis or therapy, prescriber in article 3 that the member states should make an inventory of medical and dental instruments. Such an inventory already existed at the Dutch Direct Radiation protection of DGHM. In the present investigation this inventory was actualized and analyzed further. 3 references, 11 figures, 3 tables.

42173 **(ZfI-Mitt—118) Pharmaceuticals labelled with stable isotopes. Review on preparation for application in nuclear medicine.** Krumbiegel, P. (Akademie der Wissenschaften der DDR, Leipzig. Zentralinstitut fuer Isotopen- und Strahlenforschung). Nov 1986. 122p. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE87702868.

The relatively new field of pharmaceuticals labelled with stable isotopes is reviewed. Scientific, judicial, and ethical questions are discussed concerning the application of these pharmaceuticals in human medicine. /sup 13/C, /sup 15/N, and /sup 2/H are the stable isotopes mainly utilized in metabolic function tests. Methodical contributions are given to the application of /sup 2/H, /sup 13/C, and /sup 15/N pharmaceuticals showing new aspects and different states of development in the field under discussion. 272 refs.

42174 **Computerized microtomography using synchrotron radiation from the NSLS.** Spanne, P.; Rivers, M.L. (Linkoeping Univ., Sweden; Brookhaven National Lab., Upton, NY; Chicago Univ., IL). *Nuclear Instruments and Methods in Physics Research, Section B: Beam Interactions with Materials and Atoms;* **24/25**: No. 2, 1063-1067(Apr 1987). (CONF-861114—).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Results of microtomography experiments that employ filtered radiation from the National Synchrotron Light Source X-26 Microprobe beam line are presented. These experiments have yielded images of a freeze-dried caterpillar with a spatial resolution of the order of 30 μm and show that the limit on the spatial resolution with the present apparatus will be 1 to 10 μm. Directions for improvement in synchrotron microtomography techniques and some possible applications are discussed.

42175 **Transfer of oleic acid between albumin and phospholipid vesicles.** Hamilton, J.A.; Cistola, D.P. (Boston Univ. School of Medicine, MA). *Proceedings of the National Academy of Sciences of the United States of America;* **83**: No. 1, 82-86(Jan 1986).

The net transfer of oleic acid between egg phosphatidylcholine unilamellar vesicles and bovine serum albumin has been monitored by ^{13}C NMR spectroscopy and 90% isotopically substituted [1-^{13}C]oleic acid. The carboxyl chemical shifts of oleic acid bound to albumin were different from those for oleic acid in phospholipid vesicles. Therefore, in mixtures of donor particles, the equilibrium distribution of oleic acid was determined from chemical shift and peak intensity data without separation of donor and acceptor particles. In a system containing equal masses of albumin and phospholipid and a stoichiometry of 4-5 mol of oleic acid per mol of albumin, the oleic acid distribution was pH dependent, with $\geqq$80% of the oleic acid associated with albumin at pH 7.4; association was $\geqq$90% at pH 8.0. Decreasing the pH below 7.4 markedly decreased the proportion of fatty acid bound to albumin. The distribution was reversible with pH and was independent of whether vesicles or albumin acted as a donor. These data suggest that pH may strongly influence the partitioning of fatty acid between cellular membranes and albumin. The ^{13}C NMR method is also advantageous because it provides information about the structural environments of oleic acid bound to albumin or phospholipid, the ionization state of oleic acid in each environment, and the structural integrity of the vesicles. In addition, minimum and maximum limits for the exchange rates of oleic acid among different environments were obtained from the NMR data.

5507 Microbiology

REFER ALSO TO CITATION(S) 40689, 41998, 41999, 42044, 42177

42176 **(DOE/PC/63046—T1) Investigation of the potential of Sulfolobus acidocaldarius to transform dibenzothiophene: Final report.** Krawiec, S.; Montenecourt, B.S. (Lehigh Univ., Bethlehem, PA (USA)). 31 Dec 1986. Contract AC22-83PC63046. 68p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87009898.

Archaebacteria including S. acidocaldarius appear genetically unstable and while some cultures of S. acidocaldarius may have the capacity to transform DBT the results remain unclear. A legitimate interpretation from the observations presented in this Report is that the phenotypic character of S. acidocaldarius changed during the course of the project. Because the environment in which the organism was subcultured was constant, the differences in phenotype would appear to be genetic. Culturing in the presence of 2% pristane plus DBT may be a sufficiently powerful form of selection to account for the apparent shift from DBT-sensitivity to DBT-adaptation and then from DBT-adaptation to DBT-resistance. However, any genetic change might be enhanced by an astonishing hypervariability which may possess uniquely archaebacterial features. The evidence for hypermutability comes largely from the Halobacteria. Any desulfurization process involving an Archaebacterium should include explicit means of maintaining and demonstrating the phenotypic stability of the organism which mediates the desired process. The possibility that S. acidocaldarius can degrade DBT remains tentative. 24 refs., 22 figs., 5 tabs.

5508 Morphology

42177 **Entosiphon sulcatum (Euglenophyceae): flagellar roots of the basal body complex and reservoir region.** Solomon, J.A.; Walne, P.L.; Kivic, P.A. (Univ. of Tennessee, Knoxville). *Journal of Phycology;* **23**: No. 1, 85-98(Mar 1987). Contract AC05-84OR21400.

The flagellar root system of Entosiphon sulcatum (Dujardin) Stein (Euglenophyceae) is described and compared with kinetoplastid and other euglenoid systems. An asymmetric pattern of three microtubular roots, one between the two flagellar basal bodies and one on either side (here called the intermediate, dorsal, and ventral roots), is consistent within the euglenoid flagellates studied thus far. The dorsal root is associated with the basal body of the anterior flagellum (F_1) and lies on the left dorsal side of the basal body complex. Originating between the two flagellar basal bodies, and associated with the basal body of the trailing flagellum (F_2), the intermediate root is morphologically distinguished by fibrils interconnecting the individual microtubules to one another and to the overlying reservoir membrane. The intermediate root is often borne on a ridge projecting into the reservoir. The ventral root originates near the F_2 basal body and lies on the right ventral side of the cell. Fibrillar connections link the membrane of F_2 with the reservoir membrane at the reservoir-canal transition level. A large cross-banded fiber joins the two flagellar basal bodies, and a series of smaller striated fibers links the anterior accessory and flagellar basal bodies. Large nonstriated fibers extend from the basal body complex posteriorly into the cytoplasm.

5509 Pathology

REFER ALSO TO CITATION(S) 41906, 41947, 42191

5510 Physiological Systems

REFER ALSO TO CITATION(S) 41446, 42043

42178 **(DOE/ER/13273—T1) Metabolic mechanisms of plant growth at low water potentials: Progress report.** Boyers, J.S. (Texas A and M Univ., College Station (USA)). 1987. Contract FG05-84ER13273. 9p. NTIS, PC A02. File Number DE87013191.

In higher plants, growth is more frequently limited by water than by any other environmental resource. This project seeks to identify the underlying molecular mechanisms causing the limitations with emphasis on the processes of photosynthesis and cell enlargement. Our studies of cell enlargement showed that all of the factors affecting the rate of enlargement of plant cells could be analyzed by a newly developed method involving guillotine psychrometry. The method indicated that when tissue grows rapidly, the rate of cell enlargement is co-limited by the extensiability of the cell walls and the conductance of the tissue for water. When water was limited around the roots, the growth showed dramatically and the first factor to respond was the water potential gradient that brings water into the tissue from the vascular system. The collapse of this gradient was followed in 10-20 h by metabolically-mediated decreases in wall extensibility and the conductance of the tissue for water. The change in conductance was confirmed by independent measurements with a pressure probe. The results to date indicate that the inhibition of cell enlargement was caused first by a physical signal that was followed a few hours later by metabolic alterations in the cell. The metabolic changes would need to be reversed before rates of enlargement would recover at low water potentials.

42179 **(INIS-mf—10930) Radioimmunological and clinical studies with luteinizing hormone releasing hormone (LRH).** Dahlen, H.G. (Katholieke Univ. Nijmegen (Netherlands)). 26 Nov 1986. 61p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87702796.

Radioimmunoassay for Luteinizing Hormone Releasing Hormone (LRH) has been established, tested and applied. Optimal conditions for the performance with regards to incubation time, incubation temperature, concentration of antiserum and radiolabelled LRH have been established. The specificity of the LRH immunoassay was investigated. Problems with direct measurement of LRH in plasmas of radioimmunoassay are encountered. The LRH distribution in various tissues of the rat are investigated. By means of a system for continuous monitoring of LH and FSH in women the lowest effective dose of LRH causing a significant release of LH and FSH could be established. 486 references, 38 figures, 12 tables.

42180 **(LBL—23450) Local human skin potential: Spatial distribution, magnitude and origin.** Cullander, C. (Lawrence Berkeley Lab., CA (USA)). Apr 1987. Contract AC03-76SF00098. 174p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE87012882.

This thesis investigates the sources and distribution of the slowly-varying electric potential across hairy skin and the spatial distribution of the eccrine gland pores, which may be related to the skin potential. The transdermal electrical potential in the same area on the back of the hands of eight subjects was measured under experimental conditions designed to minimize eccrine gland activity. The mean potential over all subjects was 24.86 +- 8.16 mV. The pore distribution was evaluated by transferring the imprint of pilocarpine-stimulated gland secretions on special paper to digitized arrays. The average gland count over all records for the mean electrode radius (1 mm) was 9.09 +- 3.55 glands. The correlation between the measured potential and the number of glands at each measurement site was calculated, and in general, the measured potential was independent of gland count. This lack of correlation was consistent with an equivalent circuit model for non-sudorific potential generation. This model predicted a minimal contribution from the passive glands and the existence of at least one other source of potential. One such source is regional variability in the permeability barrier of the skin. The pore location arrays were also used to make a spectral analysis of the spatial frequencies present in the point pattern. Radial profiles of the power spectra and autocorrelation estimates demonstrated that the inter-pore distance is nearly constant (0.49 +- 0.043 mm). The larger scale periodicity of 1.84 +- 0.35 mm is related to the absence of glands surrounding hair follicles. Simulations of gland distributions by a stochastic model were used to verify the uniqueness of the findings. 105 refs., 43 figs., 10 tabs.

42181 **Growth and hepatic composition in the guinea pig after long-term parenteral hyperalimentation.** Lu, C.J.H.; Redmond, D.; Baggs, R.B.; Schecter, A.; Gasiewicz, T.A. (Univ. of Rochester School of Medicine and Dentistry, NY). *American Journal of Physiology;* **251**: No. 2, R388-R397(Aug 1986). Contract AC02-76EV03490.

This study examined the feasibility of maintaining male Hartley guinea pigs on long-term hyperalimentation. Data from animals fed ad libitum, but infused with 0.9% saline, indicated that there was minimal effect from catheter implantation, sepsis, or the infusion of large volumes of fluid. This group compared with animals fed and watered ad libitum demonstrated a nearly identical growth rate serum chemistry, tissue weights, and hepatic composition and morphology. Animals infused with a total parenteral diet demonstrated growth rates of 4.06 +/- 1.46 g/day for up to 25 days. Loss

of infused animals was due in varying degrees to sepsis, mechanical failure, improper placement of the cannula, loss of patency, and death from unknown causes. Morphological analysis of animals fed by total parenteral nutrition revealed an altered distribution and increased size of lipid droplets in hepatic parenchymal and Kupffer cells and glycogen accumulation by the parenchymal cells. Decreased hepatic content of total protein and lipid, as well as cytochrome P_{450}, was also observed. Similarly, serum values of triglyceride were decreased in animals fed by the total parenteral diet. This study indicated that the guinea pig fed by hyperalimentation may be a useful animal model for a number of clinical and basic research applications.

5520 Public Health

REFER ALSO TO CITATION(S) 41099, 41600, 42261, 42287

5530 Agriculture And Food Technology

REFER ALSO TO CITATION(S) 40694, 42053, 42054, 42055, 42056, 42057, 42058, 42059, 42060, 42178, 42262, 42262, 42263, 42264, 42265, 42266

42182 **(IAEA-R—3732-F) Combined effects of irradiation and conventional methods of meat preservation on pathogenic bacteria. Final report for the period 1 October 1985-30 September 1986.** Szczawinski, J. (International Atomic Energy Agency, Vienna (Austria)). Mar 1987. 23p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702563.

Experiments were carried out to determine the effect of irradiation (3 $O_2$6 kGy) on the probability of outgrowth and toxin production by C. botulinum types A, B and E in inoculated cured pork during simulated temperature abuse. In addition, to determine whether lowering nitrite concentration and/or decrease in the risk of botulimum hazard could be achieved by combination of less curing salt, pasteurization and low dose irradiation of meat. The results demonstrated that increasing irradiation dose (0, 3, 6 kGy) systematically reduced spoilage and probability of toxin production by C. botulimum in pasteurized samples of cured meat at each level of added nitrite (0, 50, 100, 156 mg/kg). The level of nitrite presently used in some canned, pasteurized, cured meats (156 mg/kg) could be reduced to 100 mg/kg without increase of botulism hazard by irradiation with a dose of 3kGy. Decrease of botulism hazard and reduction of nitrite added into the meat could be achieved by combination of curing with 100mg/kg $NaNO_2$, pasteurization and irradiation with a dose of 6kGy. 26 references, 4 figures, 6 tables.

42183 (IAEA-TECDOC—406, pp 85) **Aflatoxins B/sub 1/ and M/sub 1/ in forage and milk of dairy animals.** Heeschen, W. (Bundesanstalt fuer Milchforschung, Kiel, Germany, F.R.). Jan 1987. NTIS (US Sales Only), PC A05/MF A01. File Number DE87702735. (CONF-8607333—Summ.).

From Research co-ordination meeting on studies of agricultural chemical residues in meat, milk and related products of livestock with the aid of nuclear techniques; Belgrade, Yugoslavia (16 Jul 1986).

42184 **(IAEA-TECDOC—411) Improvement of root and tuber crops by induced mutations. Conclusions and recommendations of the first and second research co-ordination meetings of the FAO/IAEA co-ordinated research programme on improvement of root and tuber crops and similar vegetatively propagated crop plants in tropical countries by induced mutations held in Pattaya, Thailand, 17-21 December 1984 and in Vienna, 2-6 June 1986.** (Joint FAO/IAEA Div. of Isotope and Radiation Applications of Atomic Energy for Food and Agricultural Development, Vienna (Austria)). Mar 1987. 48p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87702565.

The aim of the FAO/IAEA Co-ordinated Research Programme is to breed cultivars which are more productive, more resistant to diseases and pests and which have better quality. Two Research Co-ordination Meetings in this programme were convened. They reviewed in detail the status and breeding research needs of the major root and tuber crops and other vegetatively propagated corps, viz. cassava, yam, sweet potato, potato and sugar cane. The participants presented their research achievements and difficulties, exchanged information, co-ordinated their future research and made recommendations.

42185 **(INIS-mf—9939) Order of 21 June 1984 on trade in garlic, onions, and shallots treated by ionizing radiation.** (International Atomic Energy Agency, Vienna (Austria)). 6 Jul 1984. 1p. (In French). NTIS (US Sales Only), PC A02/MF A01. File Number DE87780141.

This Order sets the licensing conditions for possession with a view to the sale and putting on sale of onion, garlic, and shallot bulbs whose germination has been inhibited by exposure to cobalt 60 or cesium 137 gamma radiation or to accelerated electron beams with an energy below or equal to 10 million electron-volts.

42186 **(INIS-mf—10890) Techniques for assesment of opiates in body fluid and plant products.** Kongtip, P. (Chulalongkorn Univ., Bangkok (Thailand)). 1982. 81p. (In Thai). NTIS (US Sales Only), PC A05/MF A01. File Number DE87702784.

This thesis described the determination of morphine like substances in human milk, poppy seed and rice by radioimmunoassay (RIA) and gas chromatography (GC). The first technique was implemented for human milk using chloroform extracts. Among the various drugs tested only codeine was found to have cross reaction with the antibody used and the method gave a sensitivity of 60 pg/tube or 300 pg/cm^3. The coefficient of variation for both within and between assays were less than 8% whereas the percentage recovery of 10-25 ng/cm^3 of standard morphine hydrochloride added into human milk was higher than 95%. Study in 4 hill tribe opium addicted women showed that the concentration of morphine like substances in their milk ranged from 0-250 ng/cm^3. Poppy seed and rice were investigated by both GC and RIA. Poppy seed from four different sources were investigated for morphine and codeine. Over 1200 ng of the compounds were detected in one gram of all the specimen studied and codeine was present in higher concentration. Determination with RIA gave a range of 2000-6200 ng in one gram of the seeds. No detectable amount of morphine or codeine was found with GC in either 4 samples of rice obtained from hill tribe villages or in one sample of low land rice whereas 0.4-2.5 ng/g were detected with RIA.

42187 **(JEN—581) Effect of temperature and light intensity on growth and photosynthetic activity of Chlamydomonas Reinhardtii.** Alfonsel, M.; Fernandez Gonzalez, J. (Junta de Energia Nuclear, Madrid (Spain)). 1986. 88p. (In Spanish). NTIS (US Sales Only), PC A05/MF A01. File Number DE87702649.

The effect of five temperatures (15, 20, 25, 30 and 35°C) and two levels of illumination on growth and photosynthetic activity of Chlamydomonas reinhardtii has been studied. The growth of the cultures was evaluated by optical density. Photosynthetic activity has been carried out studying either the assimilation rate of CO_2 labelled with C 14 or the oxygen evolution by means of polarographic measurements. The maximum photosynthetic rate has been obtained at 25°C for the lower lavel of illumination (2400 lux) and at 35°C for the higher one (13200 lux). These results suggest an interacton of temperature and illumination on photosynthetic activity. 37 references, 14 figures.

56 BIOMEDICAL SCIENCES, APPLIED STUDIES

REFER ALSO TO CITATION(S) 41627

5601 Radiation Effects

REFER ALSO TO CITATION(S) 42069, 42075

42188 **(AD-A—180486/3/XAB) Effects of full-spectrum lighting in submarines. Interim report.** Luria, S.M. (Naval Submarine Medical Research Lab., Groton, CT (USA)). 9 Apr 1987. 23p. (NSMRL—1092). NTIS, PC A02/MF A01.

Crewmen on a nuclear submarine were monitored during two patrols, one during which the submarine was lighted with standard fluorescent lights and a second during which it was equipped with full-spectrum lights whose spectral distribution is much more similar to sunlight and emit a greater amount of high-energy ultraviolet light. The levels of 25-OH vitamin D in their blood was measured at the start and during the sixth week of each patrol. In addition, the men kept daily logs during the patrols noting such things as their health and mood. There was no evidence that the full-spectrum lights prevent the typical decline of vitamin D levels in the blood during a patrol. However, the initial levels of vitamin D in the blood were quite different, and it is difficult to interpret the results. The men preferred the full-spectrum light and rated their health as being better under this light, but this was not accompanied by higher ratings of mood or quality of sleep.

42189 **(AD-A—180614/0/XAB) Biological evaluation of radioprotective drugs. Annual report, 1 February 1986-31 January 1987.** Murray, D. (Anderson (M.D.) Hospital and Tumor Inst., Houston, TX (USA)). 3 Mar 1987. 60p. NTIS, PC A04/MF A01.

These investigations of the mechanisms of radioprotection by aminothiols involve both in vitro and in vivo systems and utilize recent advances in the techniques of alkaline and neutral elution to measure the effect of aminothiols on the induction and rejoining of γ-ray-induced DNA single-strand breaks (SSBs) and double-strain breaks (DSBs), respectively. The resulting effects are correlated with the effects of the compound on cell survival. Both WR-1065 and WR-255591 protected against SSB and DSB induction in irradiated cultured cells, although to a lesser extent than the protection for cell survival. Both compounds also inhibited SSB (but not DSB) rejoining. In the mouse jejunum, WR-2721, WR-1065, and WR-3689 provided little protection against SSB induction at doses of drug that gave considerable protection in the jejunal microcolony assay; each of the compounds retarded SSB rejoining. The cellular mechanisms resulting in radioprotection are apparently complex, and may involve qualitative as well as quantitative alterations in the DNA lesions induced by radiation; several testable hypotheses are proposed in which the effects of the drug may be mediated via a direct interaction with DNA.

42190 **(CONF-870701—3) Radiation effects in space.** Fry, R.J.M. (Oak Ridge National Lab., TN (USA)). Jul 1987. Contract AC05-84OR21400. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012529.

From 8. international congress of radiation research; Edinburgh, UK (19 Jul 1987).

As more people spend more time in space, and the return to the moon and exploratory missions are considered, the risks require continuing examination. The effects of microgravity and radiation are two potential risks in space. These risks increase with increasing mission duration. This document considers the risk of radiation effects in space workers and explorers. 17 refs., 1 fig., 4 tabs.

42191 **(CONF-8609306—1) Symposium: Carcinogenesis.** Miller, A.B.; Bruce, W.R.; Fry, R.J.M.; Hoffman, D. (Oak Ridge National Lab., TN (USA); Toronto Univ., Ontario (Canada); Ludwig Inst. for Cancer Research, Toronto, Ontario (Canada); American Health Foundation, Valhalla, NY). 1986. Contract AC05-84OR21400. 4p. RCPSC, 74 Stanley Ave., Ottawa, Ontario, KIM1P4, Canada. File Number TI87011686.

From Symposium on carcinogenesis; Toronto, Canada (22 Sep 1986).

There is much interest in the factors that cause cancer in humans. This symposium was planned as a discussion of the emerging knowledge of carcinogenesis that is being obtained from research. Focus was also placed on the implications found in cancer epidemiology. 11 refs.

42192 **(DOE/EV/02217—58) The investigation of molecular mechanisms in photodynamic action and radiobiology with nanosecond flash photolysis and pulse radiolysis: Final report for period April 1, 1972-June 30, 1987.** Grossweiner, L.I. (Illinois Inst. of Tech., Chicago (USA)). Jul 1987. Contract AC02-76EV02217. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013685.

Laser flash was employed to investigate initial photolysis mechanisms in enzymes and constituent aromatic amino acids. The key role of photoionization and solvated electron generation was demonstrated. The photochemistry of furocoumarins employed for phototherapy of skin diseases was investigated, emphasizing the production and subsequent reactions of singlet molecular oxygen. The photochemistry of porphyrins employed for photodynamic therapy of malignant tumors was studied, emphasizing photosensitization of model membranes, liposomes and resealed red blood cell membranes. Photosensitization in light-scattering media was investigated in a tissue model, consisting of polystyrene microspheres in an aqueous dye solution and analyzed with the diffusion approximation to radiative transfer. The diffusion approximation was employed to develop a dosimetry model for photodynamic therapy.

42193 **(DOE/EV/04326—7) In vivo measurements of bone-seeking radionuclides: Final report, 1984-1987.** Cohen, N.; Laurer, G.R. (New York Univ., NY (USA). Medical Center). 1987. Contract AC02-77EV04326. 130p. (COO—4326-7). NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87013018.

This document describes three years effort on eight projects investigating techniques for in vivo measurements of bone-seeking radionuclides. Included are methods for estimating radiation background in human subjects; for estimating specific organ burdens; for estimating levels of plutonium in human females; for the design of a human skull phantom; and for the development of a reference spectra library for low-energy, photon-emitting nuclides. 58 refs., 46 figs., 8 tabs. (TEM)

42194 (IAEA-TECDOC—382, pp 35-57) **Cause of radiological health damage - Biological effects of ionizing radiation.** Gonzalez, A. (International Atomic Energy Agency, Vienna, Austria. Div. of Nuclear Safety). Oct 1986. (In Spanish). NTIS (US Sales Only), PC A16/MF A01. File Number DE87702732. (CONF-8410472—).

From Regional course on legislation and regulation of nuclear safety for Latin American countries; Montevideo, Uruguay (15 Oct 1984).

This study discusses how ionizing radiation might effect human health. The author comments on the effect of such radiation in specific parts of the human body and evaluates the risk of cancer and hereditary effects caused by radiation exposure. 55 refs, 2 figs, 3 tabs.

42195 **(INIS-mf—9936) Decree No. 84-492 of 22 June 1984 revising and supplementing the tables of occupational diseases annexed to Decree No. 46-2959 of 31 December 1946 made in implementation of Book IV of the Social Security Code on preventing and compensating industrial and occupational diseases.** (International Atomic Energy Agency, Vienna (Austria)). 26 Jun 1984. 4p. (In French). NTIS (US Sales Only), PC A02/MF A01. File Number DE87780139.

This Decree amends and replaces a series of tables of occupational diseases annexed to Decree No. 46-2959 of 31 December 1946. Table No. 6 which concerns nuclear activities, already amended in 1963, has now been given a new title. The original title "diseases created by X-rays or radioactive substances" is replaced by "diseases created by ionizing radiation". Other modifications concern the diseases and time-period for taking certain of them in charge to take account of the evolution of knowledge.

42196 **(INIS-mf—9938) Circular of 23 July 1984 on installations classified for purposes of environmental protection: Application of Euratom Directive of 15 July 1980.** (International Atomic Energy Agency, Vienna (Austria)). 25 Aug 1984. 2p. (In French). NTIS (US Sales Only), PC A02/MF A01. File Number DE87780140.

This Circular analyses the consequences of the Directive of the Commission of the European Communities of 15 July 1980 on installations classified for purposes of environmental protection. The Community Directive fixes the three basic principles for protection of the environment, the public and workers: justification, optimization and limitation. Legislation on classified installations will be based on these three basic principles when preparing gener-

al regulations and standards applicable to activities involving ionizing radiation. An Annex to the Circular lists the technical measures required to prevent disamenities due to ionizing radiation.

42197 **(INIS-mf—10647) Radiation protection. Radioactivity and health. 3. Ed .** Feinendegen, L.E.; Feldmann, A.; Muench, E.; Paschke, M. (Bayerisches Staatsministerium fuer Landesentwicklung und Umweltfragen, Muenchen (Germany, F.R.); Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.)). Sep 1986. 161p. (In German). NTIS, PC E14; Available from NTIS as TIB/B87-07619.

This booklet makes an attempt at elucidating the mutual influence of radioactivity and health in a way which is understandable to the non-expert. The basics of radioactivity are briefly explained by way of introduction, the next item to be described is exposure of man to natural and artificial radiation. Somatic and genetic effects of radiation on man are subsequently dfscussed. The whole area of radioecology - starting with radioactive discharge from nuclear plants and going on to the determination of man's exposure to radiation - is covered and supplemented by a description of the risks of radiation therapy. All this serves to describe the results of long-term research on questions of the radiobiological risks in an understandable way and provide useful information about this eminently important area.

42198 (INIS-mf—10916, pp 524) **Role of DNA damage and repair in post-irradiation cell death.** Hanson, K.P. (Tsentral'nyj Nauchno-Issledovatel'skij Rentgeno-Radiologicheskij Institute, Leningrad, USSR). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

From 14. international cancer congress; Budapest, Hungary (21 Aug 1986).

42199 (INIS-mf—10916, pp 524) **Radiation damage and its repair in the formation of chromosomal exchanges and deletions.** Gundy, S. (Orszagos Frederic Joliot-Curie Sugarbiologiai es Sugaregeszseguegyi Kutato Intezet, Budapest, Hungary). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

From 14. international cancer congress; Budapest, Hungary (21 Aug 1986).

42200 (INIS-mf—10916, pp 524) **Inhibition of repair by antimetabolites in tumor cells during fractionated irradiation in vivo.** Pohlit, W. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Frankfurt am Main, Germany, F.R.). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

From 14. international cancer congress; Budapest, Hungary (21 Aug 1986).

42201 (INIS-mf—10916, pp 525) **DNA repair and its involvement in the origin of cancer in the cancer-prone hereditary diseases.** Takebe, H.; Nishigori, C.; Tatsumi, K. (Kyoto Univ., Japan). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

From 14. international cancer congress; Budapest, Hungary (21 Aug 1986).

42202 (INIS-mf—10916, pp 525) **Role of poly(ADP-ribose) in DNA-repair, DNA-replication and transformation.** Altmann, H. 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

From 14. international cancer congress; Budapest, Hungary (21 Aug 1986).

42203 (INIS-mf—10916, pp 525) **Novel pattern of post-γ ray DNA replicative synthesis in cultured radioresistant fibroblasts from affected members of a cancer-prone family.** Paterson, M.C.; Mirzayans, R. (Alberta Univ., Edmonton). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

From 14. international cancer congress; Budapest, Hungary (21 Aug 1986).

42204 (INIS-mf—10916, pp 561) **Differential radiosensitization in normal and neoplastic human cells by 3-aminobenzamide: an inhibitor of poly(ADP-ribosylation).** Thraves, P.J.; Mossman, K.L.; Dritschilo, A. (Georgetown Univ., Washington, DC). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

From 14. international cancer congress; Budapest, Hungary (21 Aug 1986).

42205 (INIS-mf—10916, pp 614) **Radiation damage to the mitogenic response of oxically and hypoxically irradiated glutathione-depleted lymphocytes supports the competition hypothesis concerning the oxygen effect.** Pellet, S.; Temesi, A.; Fachet, J.; Revesz, L. (Orszagos Frederic Joliot-Curie Sugarbiologiai es Sugaregeszseguegyi Kutato Intezet, Budapest, Hungary; Orvostudomanyi Egyetem, Debrecen, Hungary; Karolinska Institute, Stockholm, Sweden). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

From 14. international cancer congress; Budapest, Hungary (21 Aug 1986).

42206 (INIS-mf—10916, pp 616) **Effect of ionizing radiation and radioprotective WR 2721 on the lipid peroxidation in mice tissues.** Ronai, E.; Benkoe, G. (Orszagos Frederic Joliot-Curie Sugarbiologiai es Sugaregeszseguegyi Kutato Intezet, Budapest, Hungary). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

From 14. international cancer congress; Budapest, Hungary (21 Aug 1986).

42207 (INIS-mf—10916, pp 616) **Synthesis and testing of new radiosensitizing compounds: 4-substituted-3-nitro-quinoline derivatives.** Varga, L.P.; Berenyi, E. (Orszagos Frederic Joliot-Curie Sugarbiologiai es Sugaregeszseguegyi Kutato Intezet, Budapest, Hungary; Egyt Gyogyszereszeti Gyar, Budapest, Hungary). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

From 14. international cancer congress; Budapest, Hungary (21 Aug 1986).

42208 (INIS-mf—10916, pp 616) **SOD activity and radioprotective treatment in Ehrlich ascites tumor cells: is there any correlation between them.** Schweitzer, K.; Benkoe, G.; Fueresz, J.; Budavari, I. (Orszagos Frederic Joliot-Curie Sugarbiologiai es Sugaregeszseguegyi Kutato Intezet, Budapest, Hungary; Semmelweis Orvostudomanyi Egyetem, Budapest, Hungary). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

From 14. international cancer congress; Budapest, Hungary (21 Aug 1986).

42209 (INIS-mf—10916, pp 812) **Radiosensitivity testing of primary human tumor cultures as a possible predictive assay for radiocurability.** Brock, W.A.; Spitzer, G.; Bock, S.; Williams, M.; Baker, F. (Anderson, M.D. Hospital and Tumor Institute, Houston, TX; LifeTrac, Irvine, CA). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

From 14. international cancer congress; Budapest, Hungary (21 Aug 1986).

42210 (INIS-mf—10916, pp 845) **Synergistic enhancement of radiosensitivity by hyperthermia: emphasis on repair of radiation damage.** Raaphorst, G.P. (Ontario Cancer Treatment and Research Foundation, Ottawa). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

From 14. international cancer congress; Budapest, Hungary (21 Aug 1986).

42211 (INIS-mf—10916, pp 1095) **Cell transformation in vitro by neutrons of different energies: implications for mechanisms.** Barendsen, G.W.; Gaiser, J.F. (Nijverheidsorganisatie TNO, Rijswijk, Netherlands). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

From 14. international cancer congress; Budapest, Hungary (21 Aug 1986).

42212 (INIS-mf—10916, pp 1141) **Effects of the calcium antagonist flunarizine on the recovery from potentially lethal damage induced by x rays on a B16 melanoma cell line.** Bellelli, A.; Luca, G. del; Materazzi, M.; Camboni, C.; Sezzi, M.L.; Lorenzon, I.; Bellelli, L. (Regina Elena Institute, Rome, Italy). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

From 14. international cancer congress; Budapest, Hungary (21 Aug 1986).

42213 (INIS-mf—10916, pp 1289) **Molecular mechanisms of radiation-induced death of normal and tumor lymphoid cells.** Umansky, S.R.; Korol', B.A.; Nelipovich, P.A.; Afanasev, V.N.; Pechatnikov, V.A. 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

From 14. international cancer congress; Budapest, Hungary (21 Aug 1986).

42214 (INIS-mf—10916, pp 560) **Role of water in the radiosensitization of hydrated electron scavengers.** Gazso, G.L.; Dam, A. (Orszagos Frederic Joliot-Curie Sugarbiologiai es Sugaregeszseguegyi Kutato Intezet, Budapest, Hungary). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

From 14. international cancer congress; Budapest, Hungary (21 Aug 1986).

42215 (INIS-mf—10916, pp 615) **Radiosensitizing effect of dibromodulcitol.** Dam, A.M.; Gazso, G.L.; Institoris, L. (Orszagos Frederic Joliot-Curie Sugarbiologiai es Sugaregeszseguegyi Kutato Intezet, Budapest, Hungary; Chinoin Gyogyszer es Vegyeszeti Termekek Gyara Rt., Budapest, Hungary). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

From 14. international cancer congress; Budapest, Hungary (21 Aug 1986).

42216 (INIS-mf—10916, pp 485) **Mechanism of radiation- or chemically-induced T-cell lymphomagenesis in mice.** Yokoro, K.; Yanagihara, K. (Hiroshima Univ., Japan). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

From 14. international cancer congress; Budapest, Hungary (21 Aug 1986).

42217 (INIS-mf—10916, pp 486) **Independent induction of gastric tumors and intestinal metaplasias in rats given localized x-irradiation or MNNG at gastric region.** Hirose, F.; Watanabe, H.; Ito, A. (Hiroshima Univ., Japan). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

From 14. international cancer congress; Budapest, Hungary (21 Aug 1986).

42218 (INIS-mf—10916, pp 486) **Chromatid radiosensitivity during the G_2 cell-cycle phase and susceptibility to plasmacytomagenesis in mice.** Sanford, K.K.; Parshad, R.; Potter, M. (Howard Univ., Washington, DC). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

From 14. international cancer congress; Budapest, Hungary (21 Aug 1986).

42219 (INIS-mf—10916, pp 560) **Radiosensitizing effect of the synthetic microtubule inhibitor tubulozole on murine MO_4 fibrosarcomas in vivo.** Distelmans, W.; Van Ginckel, R.; Vanherck, W.; Willebrords, R.; De Brabander, M. (Janssen Pharmaceutica, Beerse, Belgium). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

From 14. international cancer congress; Budapest, Hungary (21 Aug 1986).

42220 (INIS-mf—10916, pp 614) **Recovery of erythropoiesis after Leucotrofina treatment in irradiated mice.** Uray, Z.; Radulescu, E.; Bara, A.; Maniu, M.; Ban, C. (Oncological Institute, Cluj-Napoca, Romania). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

From 14. international cancer congress; Budapest, Hungary (21 Aug 1986).

42221 (INIS-mf—10916, pp 614) **Radioprotective effect of locally administered Glypressin on the rectal mucosa in the rat.** Bjelkengren, G.; Aronsen, K.F.; Augustsson, N.E.; Borgstroem, S.; Lindstroem, C.; Nylander, G. (Malmoe Allmaenna Sjukhus, Sweden). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

From 14. international cancer congress; Budapest, Hungary (21 Aug 1986).

42222 (INIS-mf—10916, pp 615) **Individual selection of radiosensitizers and fractionation schedules for more effective radiation treatment of cancer. A new method.** Grashev, G. (Nauchno-Izsledovatelski Onkologichen Institute, Sofia, Bulgaria). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

From 14. international cancer congress; Budapest, Hungary (21 Aug 1986).

42223 (INIS-mf—10916, pp 1095) **Alterations in brain of developing mice after 0.5 Gy neutron irradiation in utero.** Antal, S.; Fonagy, A.; Hidvegi, E.J.; Fueloep, Z. (Orszagos Frederic Joliot-Curie Sugarbiologiai es Sugaregeszseguegyi Kutato Intezet, Budapest, Hungary). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

From 14. international cancer congress; Budapest, Hungary (21 Aug 1986).

42224 (INIS-mf—10916, pp 1095) **Tumor induction in monkeys and rats after neutron irradiation.** Broerse, J.J. (Nijverheidsorganisatie TNO, Rijswijk, Netherlands). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

From 14. international cancer congress; Budapest, Hungary (21 Aug 1986).

42225 (INIS-mf—10916, pp 560) **Mechanisms of modifications of responsiveness to drugs in microregions of solid tumors.** Sutherland, R.; Heacock, C.; Ling, L.; Michel, G.; Sciandra, J.; Wilson, R. (Rochester Univ., NY). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

From 14. international cancer congress; Budapest, Hungary (21 Aug 1986).

42226 (INIS-mf—10916, pp 813) **Function of hematopoietic stem cells in thyroid tumor patients among A-bomb survivors.** Takeichi, N.; Dohi, K.; Nishiki, M.; Okamoto, H.; Fujikura, T.; Niho, Y. (Hiroshima Univ., Japan; Radiation Effects Research Foundation, Hiroshima, Japan; Kyushu Univ., Fukuoka, Japan). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

From 14. international cancer congress; Budapest, Hungary (21 Aug 1986).

42227 (INIS-mf—10916, pp 1095) **Radiobiological effects of very heavy charged particles and their interpretation.** Kraft, G.; Kraft-Weyrather, W. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt, Germany, F.R.). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

From 14. international cancer congress; Budapest, Hungary (21 Aug 1986).

42228 (INIS-mf—10916, pp 560) **Predictive assays for identifying tumors which might benefit from radiotherapy with sensitizers and/or protectors.** Chapman, J.D.; Urtasun, R.C. (Alberta Univ., Edmonton). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

From 14. international cancer congress; Budapest, Hungary (21 Aug 1986).

42229 (INIS-mf—10916, pp 811) **Predicting radiosensitivity of individual tumors and normal tissues.** Streffer, C. (Essen Univ., Gesamthochschule, Germany, F.R.). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

From 14. international cancer congress; Budapest, Hungary (21 Aug 1986).

42230 (INIS-mf—10916, pp 812) **Parameters of the fractionation response of normal tissues.** Withers, H.R. (California Univ., Los Angeles). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

From 14. international cancer congress; Budapest, Hungary (21 Aug 1986).

42231 (INIS-mf—10916, pp 1141) **Radiosensitivity test for cancer of uterine cervix.** Noguchi, H.; Shiozawa, I.; Kitahara, T.; Yamazaki, T.; Fukuta, T.; Tsukahara, Y.; Iwai, S. (Shinshu Univ., Matsumoto, Nagano, Japan; Yamanashi Medical College, Japan). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

From 14. international cancer congress; Budapest, Hungary (21 Aug 1986).

42232 (INIS-mf—10916, pp 1143) **Effect of the prostaglandin-leukotrien inhibitor Meclomen on alleviating radiation induced mucositis and carcinogenesis in radiation therapy.** Tjota, A.; Halpern, J.; Mahafza, M.; Ambrus, J.L. (Roswell Park Memorial Institute, Buffalo, NY; State Univ. of New York, Buffalo). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

From 14. international cancer congress; Budapest, Hungary (21 Aug 1986).

42233 (INIS-mf—10916, pp 561) **Radioprotective effect of intra-arterial Vasopressin during fractionated abdominal radiation.** Bjelkengren, G.; Aronsen, K.F.; Augustsson, N.E.; Borgstroem, S.; Lindstroem, C.; Nylander, G. (Malmoe Allmaenna Sjukhus, Sweden). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

From 14. international cancer congress; Budapest, Hungary (21 Aug 1986).

42234 (INIS-mf—10929) **Radiobiological properties of the spermatogonial stem cell population during the cycle of the spermatogenetic epithelium.** Beek, M.E.A.B. van. (Rijksuniversiteit Utrecht (Netherlands)). 9 Sep 1986. 123p. (In Dutch). NTIS (US Sales Only), PC A06/MF A01. File Number DE87702795.

In this thesis a study is presented on the survival of spermatogonial stem cells in the mouse after irradiation with fission neutrons with a mean energy of 1 Mev and on the recovery process of the spermatogenetic epithelium which is damaged by the irradiation, during the first few weeks after the irradiation. The study has been performed with mice of the Cpb-N stem.

42235 (INIS-mf—10931) **Ionizing radiation and the thymus. Effects of whole-body irradiation with fast fission neutrons and X-rays on the murine thymus.** Huiskamp, R. (Erasmus Univ., Rotterdam (Netherlands)). 1 Oct 1986. 237p. NTIS (US Sales Only), PC A11/MF A01. File Number DE87702797.

In this thesis the effects of whole body irradiation with fast fission neutrons and X-rays on the murine thymus are studied. Young adult CBA mice were exposed to whole body irradiation with either fast fission neutrons or X-rays. The results of the investigation of short- and long-term effects of the irradiation on the thymus showed a biphasic regeneration pattern followed by a marked decrease in relative thymus weight and cellularity which lasted up to at least 250 days. This late effect is attributed to possible loss of pluripotent stem cells and residual damage in the surviving stem cells in the bone marrow. The immunohistology of T cell subpopulations in the thymus of normal CBA/H mice was analyzed in order to describe the T cell composition of the irradiated thymus. The effects of irradiation with fast fission neutrons on the stromal cells of the thymus are studied in order to investigate whether the thymic stromal cells are involved in the regeneration process. The effect of graded doses of fission neutrons or X-rays on the lymphoid compartment on the thymus are studied in order to investigate the radiosensitivity of thymocyte subpopulations for these radiation types. Also the effects on the stromal compartment of the thymus are investigated.

42236 (INIS-XN—60) **Epidemiological studies of general population groups exposed to low-level radiation.** Davies, J.M.; Inskip, H. (Nuclear Energy Agency, 75 - Paris (France)). 1986. 48p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87702601.

The exposure of man to radiation and the resulting risk of carcinogenesis continue to be of concern to the public. In this context, there is often a tendency to carry out epidemiological studies concerning the induction of cancer in radiation workers and members of the public which are not supported by a statistically valid data base or whose result are misinterpreted or misused. To assist national authorities in evaluating radiological risks, the Nuclear Energy Agency has sponsored a critical review of the methodologies for, and the limitations of, these epidemiological studies, and of the precautions to be adopted in interpreting their results. Prepared by two consultants, Dr. Joan M. Davies and Dr. Hazel Inskip, the review focuses on the problems encountered when carrying out epidemiological studies on groups of the general population exposed to radiation, and using their results for radiological protection purposes. The primary objective is to provide background material for national authorities who have responsibilities in the field of radiological protection, as well as to other persons interested in this subject. It is published under the responsibility of the Secretary General of the OECD, and does not necessarily reflect the views of Member Governments.

42237 (JEN—585) **Implication of the E. coli K12 uvrA and recA genes in the repair of 8-methoxypsoralen-induced monoadducts and crosslinks on plasmid DNA.** Paramio, J.M.; Bauluz, C.; Vidania, R. (Junta de Energia Nuclear, Madrid (Spain)). 1986. 76p. (In Spanish). NTIS (US Sales Only), PC A05/MF A01. File Number DE87702651.

Genotoxicity of psoralen damages on plasmid DNA has been studied. pBR322 DNA was randomly modified with several concentrations of 8-methoxypsoralen plus 365 nm-UV light. After

transformation into E. coli strains (wild-type, uvrA and recA) plasmid survival and mutagenesis were analyzed. To study the influence of the SOS response on plasmid recovery, preirradiation of the cells was performed. In absence of cell preirradiation, crosslinks were not repaired in any strain. Monoadducts were also lethal but in part removed by the excision-repair pathway. Preirradiation of the cells significantly increased plasmid recovery in recA cells. In uvrA only the mutagenic pathway seemed to be involved in the repair of the damaged DNA. Wild type strain showed the highest increase in plasmid survival, involving the repair of monoadducts and some fraction of crosslinks mainly through an error-free repair pathway. This suggests an enhancement of the excision repair promoted by the induction of SO functions. 32 references, 16 figures.

42238 **(MLM—3437(OP)) Special effects of medical radioisotopes on lung monitoring.** Tomlinson, F.K.; Johnson, V.S. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 1987. Contract AC04-76DP00053. 7p. (CONF-8706148—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011839.

From Actinide in-vivo measurement workshop; Cromwell, CT, USA (3 Jun 1987).

Mound developed a program to cope with employees who needed to be lung monitored for plutonium, yet who had been exposed to various radioisotopes used for medical diagnostic examinations. The methods developed are described as well as a recent special case where an employee's routine lung count was initially mistaken for Americium-241, when in fact the uptake came from contact with his spouse who had received a medical radioisotope.

42239 (PNL—6100-Pt.1, pp 5-19) **Inhaled plutonium oxide in dogs.** Park, J.F. Feb 1987. NTIS, PC A06/MF A01. File Number DE87010024.

In Pacific Northwest Laboratory: annual report for 1986 to the DOE Office of Energy Research: Part 1, Biomedical Sciences.

This project is concerned with long-term experiments to determine the lifespan dose-effect relationships of inhaled $^{239}PuO_2$ or $^{238}PuO_2$ in beagles. The data will be used to estimate the health effects of inhaled transuranics. Beagle dogs given a single exposure to $^{239}PuO_2$ or $^{238}PuO_2$ aerosols to obtain graded levels of initial lung burdens (ILB) are being observed for lifespan dose-effect relationships. Mortality due to radiation pneumonitis and lung tumor increased in the four highest dose-level groups exposed to $^{239}PuO_2$ during the 15-year postexposure period. During the 12 1/2 years after exposure to $^{238}PuO_2$, mortality due to lung and/or bone tumors increased in the three highest dose-level groups. Chronic lymphopenia, occurring 0.5 to 2 years after exposure, was the earliest observed effect after inhalation of either $^{239}PuO_2$ or $^{238}PuO_2$ in the four highest dose-level groups that had ILB of $\geq$ 80 nCi. Other plutonium-exposure-related effects include sclerosis of the tracheobronchial lymph nodes, focal radiation pneumonitis, adenomatous hyperplasia of the liver, and dystrophic osteolytic lesions in the skeleton. 4 figures, 7 tables.

42240 (PNL—6100-Pt.1, pp 21-25) **Inhaled plutonium nitrate in dogs.** Dagle, G.E. Feb 1987. NTIS, PC A06/MF A01. File Number DE87010024.

In Pacific Northwest Laboratory: annual report for 1986 to the DOE Office of Energy Research: Part 1, Biomedical Sciences.

The major objective of this project is to determine dose-effect relationships of inhaled plutonium nitrate in dogs to aid in predicting health effects of accidental exposure in man. For lifespan dose-effect studies, beagle dogs were given a single inhalation exposure to $^{239}Pu(NO_3)_4$, in 1976 and 1977. The earliest biological effect was on the hematopoietic system; lymphopenia and neutropenia occurred at the two highest dose levels. They have also observed radiation pneumonitis, lung cancer, and bone cancer at the three highest dose levels. 1 figure, 3 tables.

42241 (PNL—6100-Pt.1, pp 27-30) **Oncogenes in radiation carcinogenesis.** Frazier, M.E. Feb 1987. NTIS, PC A06/MF A01. File Number DE87010024.

In Pacific Northwest Laboratory: annual report for 1986 to the DOE Office of Energy Research: Part 1, Biomedical Sciences.

Lung tumors obtained from studies of lifespan, dose-effect relationships in beagle dogs exposed to plutonium by inhalation are being used for studying mechanisms of radiation-induced carcinogenesis. Specifically, they are examining the role of known oncogenes in lung tumors induced by the internally deposited radionuclides plutonium-238 and plutonium-239. The initial phase of this research is attempting to determine whether oncogenes are involved in plutonium-induced lung cancers and, if so, their role in the carcinogenic process. 2 figures, 4 tables.

42242 (PNL—6100-Pt.1, pp 37-39) **Inhalation hazards to uranium miners.** Cross, F.T. Feb 1987. NTIS, PC A06/MF A01. File Number DE87010024.

In Pacific Northwest Laboratory: annual report for 1986 to the DOE Office of Energy Research: Part 1, Biomedical Sciences.

Using both large and small experimental animals, this project is investigating levels of uranium-mine air contaminants that produce respiratory system disease in miners. Lung cancer incidence and deaths from degenerative lung disease are significantly elevated among uranium miners, but the cause-effect relationships for these diseases are based on inadequate epidemiological data. This project identifies agents or combinations of agents (both chemical and radiological), and their exposure levels, that produce respiratory tract lesions, including respiratory epithelial carcinoma, pneumoconiosis, and emphysema. Histopathological data for 100-working-level (WL) exposure rates show a significant increase in lung tumor risk over 1000-WL exposure rates for comparable cumulative radon-daughter exposures. Exposure of rats to radon daughters and other contaminants continues; the exposure of beagle dogs to uranium ore dust alone was terminated. Renal function and hematology data on ore-dust-exposed dogs are reported. 1 figure, 5 tables.

42243 (PNL—6100-Pt.1, pp 47-50) **Fetal and juvenile radiotoxicity.** Sikov, M.R. Feb 1987. NTIS, PC A06/MF A01. File Number DE87010024.

In Pacific Northwest Laboratory: annual report for 1986 to the DOE Office of Energy Research: Part 1, Biomedical Sciences.

This project is obtaining comparative information on the deposition, distribution, retention, and toxicity of radionuclides in prenatal and juvenile mammals. Because quantitative data cannot necessarily be extrapolated to man, emphasis is on identifying patterns, phenomenologic interactions, and relationships which might be useful in radiological protection practices for rapidly growing infants or children and for pregnant women. It was found that about two-thirds of the osteogenic sarcomas that resulted from exposure of rats to ^{239}Pu during late gestation originated in the bones of the head, and only one-third developed in the axial and appendicular skeleton. The incidences of soft-tissue lesions, including tumors, were significantly greater in these prenatally exposed rats than in groups that were exposed postnatally or were not exposed to plutonium. In other studies, evaluation of radiation doses from ^{233}U indicated that the observed embryotoxic and teratogenic effects were attributable to chemical toxicity and maternal effects rather than to a radiation effect on the conceptus. Results of a pilot study with ^{233}U suggest that prenatal exposure affects the postnatal development of kidney function. 3 figures, 2 tables.

42244 (PNL—6100-Pt.1, pp 51-52) **Gut-related studies of radionuclide toxicity.** Sullivan, M.F. Feb 1987. NTIS, PC A06/MF A01. File Number DE87010024.

In Pacific Northwest Laboratory: annual report for 1986 to the DOE Office of Energy Research: Part 1, Biomedical Sciences.

This project is concerned with the behavior of radioactive materials that may be ingested as a consequence of a reactor accident, unavoidable occupational exposure, or after release to the environment and incorporation into the food chain. Current emphasis is on evaluating hazards from ingested actinides as a function of animal age, species, nutrition, and diet, or chemicophysical state of the actinide. 2 tables.

42245 (PNL—6100-Pt.1, pp 79-80) **Blood irradiator development for medical applications.** Hungate, F.P.; Weller, R.E. Feb 1987. NTIS, PC A06/MF A01. File Number DE87010024.

In Pacific Northwest Laboratory: annual report for 1986 to the DOE Office of Energy Research: Part 1, Biomedical Sciences.

Histopathological evaluation of renal tissues obtained from dogs that have received transplants revealed a difference in the ap-

pearance of the rejection response between irradiated and non-irradiated animals, indicating that the irradiator may positively affect the outcome of transplants. Also during this year, the irradiator connector design was modified to better fit the newly developed radiation shielding. 3 figures.

42246 **(PNL-SA—14764) US progress on the development of CR-39 based neutron dosimeters.** Hadlock, D.E. (Pacific Northwest Lab., Richland, WA (USA)). Jun 1987. Contract AC06-76RL01830. 9p. (CONF-870525—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012161.

From Workshop on development of personnel neutron dosimeters based on track etch detectors; Harwell, UK (12 May 1987).

Historically at US nuclear facilities, two types of personnel neutron dosimeters have been in routine use: nuclear track emulsion-Type A (NTA) film and thermoluminescent dosimeter (TLD)-albedo. Both of these dosimeters have energy-dependent responses. Therefore, the neutron energy spectra must be known, to interpret the dosimeter results properly. A new state-of-the-art dosimetry system has been developed within the US Department of Energy (US DOE) Personnel Neutron Dosimeter Evaluation and Upgrade Program. This system is called the combination thermoluminescent dosimeter/track etch dosimeter (TLD/TED). This paper briefly describes US DOE research currently being conducted to further enhance the TED portion of the combination TLD/TED system. The research areas involved include dose sensitivity, neutron energy range, specialized radiators, self-developing dosimeters, and neutron spectrometry. 1 fig., 1 tab.

42247 **(PNL-SA—14915) Optimization and ALARA [as low as reasonably achievable] considerations in the use of respiratory protection in radiation areas.** Merwin, S.E.; Brown, R.C.; Martin, J.B. (Pacific Northwest Lab., Richland, WA (USA); Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Jun 1987. Contract AC06-76RL01830. 6p. (CONF-870705—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012162.

From Annual meeting of the Health Physics Society; Salt Lake City, UT, USA (5 Jul 1987).

This document described factors to be considered in the use of respiratory protection in areas of limited radiation hazard. The frequency cited standard of "as low as reasonably achievable (ALARA) was discussed and various interpretations and examples presented. A list of variables to consider before issuing a respirator to a worker was reviewed and suggested as a basis for such decisions. 4 refs. (TEM)

42248 **(RERF-TR—2-86) Sensitivity to radiation of human normal, hyperthyroid, and neoplastic thyroid epithelial cells in primary culture.** Miller, R.C.; Hiraoka, T.; Kopecky, K.J.; Nakamura, N.; Jones, M.P.; Ito, T.; Clifton, K.H. (Radiation Effects Research Foundation, Hiroshima (Japan)). Sep 1986. 15p. (In Japanese). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702657.

Samples of thyroid tissue removed surgically from 63 patients were cultured in vitro and X-irradiated to investigate the radiosensitivities of various types of thyroid epithelial cells. A total of 76 samples were obtained, including neoplastic cells from patients with papillary carcinoma (PC) or follicular adenoma (FA), cells from hyperthyroidism (HY) patients, and normal cells from the surgical margins of PC and FA patients. Culturing of the cells was performed in a manner which has been shown to yield a predominance of epithelial cells. Results of colony formation assays indicated that cells from HY and FA patients were the least radiosensitive: when adjusted to the overall geometric mean plating efficiency of 5.5 %, the average mean lethal dose D_0 was 97.6 cGy for HY cells, and 96.7 cGy and 94.3 cGy, respectively, for neoplastic and normal cells from FA patients. Cells from PC patients were more radiosensitive, normal cells having an adjusted average D_0 of 85.0 cGy and PC cells a significantly ($p = .001$) lower average D_0 of 74.4 cGy. After allowing for this variation by cell type, in vitro radiosensitivity was not significantly related to age at surgery ($p = .82$) or sex ($p = .10$). These results suggest that malignant thyroid cells may be especially radiosensitive.

42249 **(RERF-TR—10-82) Soft x rays for radiobiological studies.** Ban, S.; Iida, S.; Shimba, H.; Awa, A.A.; Hamilton, H.B.; Clifton, K.H. (Radiation Effects Research Foundation, Hiroshima (Japan)). Apr 1986. 8p. (In Japanese). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702658.

Lethal effects and chromosome aberrations induced in cells exposed to low energy (soft) X rays demonstrated that these relatively low energy X rays are just as effective as those of higher energy for radiobiological studies, and even more effective for irradiating cultured mammalian cells than laboratory animals.

42250 **(RERF-TR—20-85) Serum TSH, thyroglobulin, and thyroid disorders in atomic bomb survivors exposed in youth: a study 30 years after exposure.** Morimoto, I.; Yoshimoto, Y.; Sato, .Hamilton, H.B.; Kawamoto, S.; Izumi, M.; Nagataki, S. (Radiation Effects Research Foundation, Hiroshima (Japan)). Aug 1986. 24p. (In Japanese). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702659.

A study of individuals in Hiroshima and Nagasaki who were under 20 years of age at the time of atomic bomb exposure and who had been exposed to 100+ rad was conducted to determine the frequency of thyroid disorders as well as the levels of serum thyroid stimulating hormone (TSH), antithyroglobulin antibody, and thyroglobulin (TG), 30 years after exposure. Thyroid disorders were detected in 56 of the 477 subjects of the 100+ rad exposed group and in 39 of the 501 subjects of the 0 rad exposed group, the prevalence being significantly higher in the former group ($X^2 = 3.872$, $P = 0.049$). This increased prevalence of thyroid disorders in the 100+ rad exposed group was due to the increased occurrence of thyroid cancer and nontoxic uninodular goiter. Thyroid cancer was found in eight exposed individuals, all of whom belonged to the 100+ rad group; statistically, the prevalence was significantly higher ($X^2 = 7.919$, $P = 0.005$). Nontoxic uninodular goiter was observed in 13 cases of the 100+ rad exposed group and 3 cases of the 0 rad exposed group, the prevalence in the 100+ rad exposed group being significantly higher ($X^2 = 6.584$, $P = 0.010$). In these cases no increase of serum TSH or TG levels was observed. Mean serum TSH levels in individuals without thyroid disorders were 1.64 +- 1.89 μU/ml ($n = 421$) in the 100+ rad exposed group and 1.54 +- 1.86 μU/ml ($n = 462$) in the 0 rad exposed group. Mean serum TG levels were 13.49 +- 13.88 ng/ml ($n = 421$) in the 100+ rad exposed group and 14.76 +- 15.69 ng/ml ($n = 462$) in the 0 rad exposed group. Thus, these differences between the two groups were not significant. Also, no significant differences were observed between the 100+ rad and 0 rad exposed groups in the mean serum TSH and TG levels of the subjects who had thyroid diseases but had not been treated for the diseases, and the subjects who had no thyroid diseases.

42251 (ZfI—64, pp 15-16) **DOSKMF2, DOSKMF3 - calculation of dose rate distributions in gamma irradiation facilities.** Remer, M. Dec 1986. NTIS (US Sales Only), PC A03/MF A01. File Number DE87702867.

In Computer codes for problems of isotope and radiation research.

42252 (ZfI—64, pp 16) **ISORADL - graphical representation of dose rate distributions.** Remer, M. Dec 1986. NTIS (US Sales Only), PC A03/MF A01. File Number DE87702867.

In Computer codes for problems of isotope and radiation research.

42253 **Comparison of microscopic dose with average dose near high energy heavy ions.** Metting, N.F. (Battelle Pacific Northwest Labs., Richland, WA). *Nuclear Instruments and Methods in Physics Research, Section B: Beam Interactions with Materials and Atoms;* **24/25**: No. 2, 1050-1053(Apr 1987). (CONF-861114—).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Biophysical studies indicate that the mechanisms responsible for radiation effects involve injury to cell substructures much smaller than a cell nucleus. Therefore, in order to understand the molec-

ular mechanisms responsible, it is important to know the amount of dose deposited in the microscopic volumes of interest for a particular biological endpoint. In the case of heavy ion passage through tissue, the local pattern of energy deposition in critical volumes is strongly influenced by the structure of the track. At the Bevalac in Berkeley, a small proportional counter mounted in a large vacuum chamber was used to measure single event energy deposition distributions as a function of the distance radially outward from the primary ion path, for a 1.3 μm diameter site. It was found that the distribution of energy deposited only by delta-rays in the site resembled that of 170 kVp X-rays, and also that the specific energy (microscopic dose) for those sites exceeded the calculated average radial dose by two orders of magnitude at large radial distances.

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REFER ALSO TO CITATION(S) 40416, 40417, 40418, 40455, 40456, 40477, 40478, 41271, 41444, 41873, 41878, 41886, 41915, 41948, 41954, 42043, 42053, 42054, 42055, 42056, 42057, 42058, 42059, 42060, 42191, 42216

42254 **(AD-A—180190/1/XAB) Uptake of heavy metals from contaminated soils by salt-marsh plants. Final report, March 1983-September 1986.** Huiskes, A.H.; Nieuwenhuize, J. (Koninklijke Nederlandse Akademie van Wetenschappen, Yerseke (Netherlands). Delta Inst. voor Hydrobiologisch Onderzoek). Dec 1986. 57p. NTIS, PC A04/MF A01.

In 1984 a greenhouse experiment was carried out with Spartina alterniflora, Aster tripolium, and Puccinellia maritima. Uptake of heavy metals from contaminated soils dredged from the Western Scheldt estuary was measured in these plants. After the first harvest, the underground parts of the plants were left untouched to allow regrowth for an additional 90 days period. After this period the buckets were again harvested and the shoots analyzed. During both the growth and regrowth phases, the plants were kept in buckets with different water and salinity regimes: inundated versus drained, high salinity versus low salinity. Regrowth was very bad for Aster tripolium and for Puccinellia maritima at high salt conditions. Therefore only the results of P. maritima growth at low salt conditions and S. alterniflora wre statistically analyzed. Out of 42 comparisons between the first and the second harvest, with respect to Cd, Pb, Fe, Mn, Cu, Zn, and As levels, 25 gave statistically significant differences. Levels of Cd, Mn and Cu of the regrowth shoots of the second harvest were higher in general than of the first harvest. In contrast, levels of Fe generally were lower. Comparisons of Pb, Zn and As levels gave variable results.

42255 **(AD-A—180198/4/XAB) Evaluation of the acute toxicity of selected groundwater contaminants. Technical report, October 1985-February 1986.** Kinkead, E.R.; Leahy, H.F. (Northrop Services, Inc./Environmental Sciences, Dayton, OH (USA)). Apr 1987. 13p. NTIS, PC A02/MF A01.

Acute dermal and inhalation toxicology studies were conducted on several selected groundwater contaminants to provide additional data for hazard evaluations by Air Force personnel. Four of the compounds; Tetrachloroethylene, 1,1,1 -Trichloroethane, Chlorobenzene, and 1,1-Dichloroethylene were tested for acute dermal toxicity; 2,3-Dimethylphenol and 1,1-Dichloroethane were tested for acute 4-hour inhalation toxicity. Rabbits dermally treated with an upper limit dose of 2 ml/kg did not demonstrate symptoms of toxicity. Saturated vapors of 2,3-Dimethylphenol did not result in mortality among exposed rats after 4 hours. However, 4-hour inhalation exposures to 1,1-Dichloroethane predicted an LC50 of approximately 13,000 ppm when using male rats.

42256 **(AD-A—180425/1/XAB) US Army institute of dental research annual progress report, fiscal year 1983 (1 October 1982-30 September 1983).** Sweeney, T.P. (Army Inst. of Dental Research, Washington, DC (USA)). 1 Oct 1983. 61p. NTIS, PC A04/MF A01.

Management of Dental Injury and Combat Dentistry. The objectives are to obtain information by the techniques of clinical and basic research on injuries and diseases, except communicable diseases, commonly seen in soldiers, especially in field operations and overseas. The work is divided according to the major dental specialties. Emphasis is placed on diseases and injuries that are receiving little or no study by civilian research groups, and the work is aimed at providing better preventive measures as well as treatment. Combat Maxillofacial Injury. The objectives are to develop simplified procedures for the care of complex maxillofacial wounds and injuries which require long time-consuming procedures for reconstruction; to achieve minimal morbidity rates from oral emergencies, preventable oral disease, and restorative failures; and to develop more efficient, simplified, effective clinical and laboratory techniques which will result in better utilization of manpower and a saving in time and materiel. Medical Defense Against Chemical Agents. The objectives and purposes are the development of the basic scientific data required for systems of solider CW agent antidotes, soldier/patient decontamination, and medical management of CW casualties.

42257 (CONF-8510250—, pp 64-85) **Atmospheric deposition and forest pest interactions.** Smith, W.H. (Yale Univ., New Haven, CT). May 1987. NTIS, PC A 11. File Number DE87009894.

From Department of Energy (DOE) meterology workshop; Lake Placid, NY, USA (1 Oct 1985).

The interactions between air pollutants and forest insects are examined because of the importance of these animals to forest ecosystem structure and function. Air pollution is an environmental stress factor capable of predisposing forest trees to detrimental insect influence. Little is known about the impact of acidic deposition on forest pest interactions. However, an attempt is made to review the literature in an effort to evaluate the effect of acid rain on the processes of forest ecosystem structure and function as well as pest activity.

42258 (CONF-8510250—, pp 205-210) **Summary of current position on air quality and forest productivity.** Lucier, A.A. (National Council of the Paper Industry for Air and Stream Improvement, New York, NY). May 1987. NTIS, PC A 11. File Number DE87009894.

From Department of Energy (DOE) meterology workshop; Lake Placid, NY, USA (1 Oct 1985).

There is no convincing evidence of a wide-spread decline in forest productivity due to air pollutants. However, the possibility of such a decline now or in the future cannot be ruled out without additional research. Many types of research are needed including studies of pollutant emission, transport, transformation, deposition and effects. Approaches which could provide information needed to estimate impacts of pollutants on forest productivity are discussed. 12 References.

42259 (CONF-8510250—, pp 211-221) **Biochemical indicators of biomass decline.** Endress, A.G. (Illinois Natural History Survey, Champaign). May 1987. NTIS, PC A 11. File Number DE87009894.

From Department of Energy (DOE) meterology workshop; Lake Placid, NY, USA (1 Oct 1985).

Natural and managed ecosystems are continuously subjected to natural or anthropogenic conditions that cause stress, conditions such as drought, salinity, air pollution, or pathogen attacks. The identification and use of biochemical indices as early warning signals of distress is one of several vehicles available today to critically examine stressed ecosystems. Available evidence supports the hypothesis that photochemical oxidants (primarily ozone) and sulfur dioxide, acting singly or combined, are the primary causal agents of forest decline with acidic precipitation acting secondarily to intensify the stress. Thus, likely biochemical indicators of stress are those compounds or processes elicited in plants by oxidants. There are several candidates representing different levels of biological organization: photosynthesis, respiration, ATP biosynthesis, membrane dysfunctions, activities of specific enzymes, etc. The measures indicated are stress-dependent, but they are not stress-specific. They do serve as early warning signals of stress. The majority of potential biochemical stress indicators have been identified following studies that were generally short-term and frequently used high pollutant concentrations. New research is vitally needed to relate the temporal occurrence of stress biochemicals, to recognize that responses to stress may vary on time scales from the immediate to delayed, and to examine the effect of continued stress on stress responses. 15 references.

42260 (CONF-8706172—1) **Asbestos substitutes: A closer look at potential health hazards.** Myers, G.E. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011438.

From 24. annual American Society for Hospital Engineering conference; San Diego, CA, USA (1 Jun 1987).

It appears that, with the possible exception of some relatively minor, specialized uses, the need for asbestos in industrial and consumer products has come to an end. Although there are apparent cost or performance penalties in some applications, adequate substitute materials have been found. It seems likely that these penalties will diminish with time. The existence of asbestos materials in older structures, however, will require continued vigilance. Although no material is completely safe under all conditions of exposure, the health hazards of many asbestos substitutes are relatively minor. Mica and perlite are low hazard materials, unless the perlite has >1% free silica. Vermiculite is presumed to be of low hazard potential, unless it is contaminated with asbestos fibers. Ordinary fibrous glass is one of the most common substitute materials, and it is of low inhalation hazard. Ultrafine glass fibers may be hazardous, but their use is thus far limited to special applications. Mineral wools are considered to be of low hazard by an acknowledged authority, ACGIH; however, some mineral wools have a high fraction of thin fibers, and these may be of higher hazard potential. Thin ceramic fiber material is presumed by many to be as hazardous as the asbestos it replaces, but a recently-completed animal study found no excess cancers. The uses of carbon fiber material are highly specialized, and there is little information on health effects as yet. Organic fibers appear to be of very low hazard potential. 8 refs.

42261 (EPRI-EA—5358) **Risk assessment of toxic pollutants from fossil fuel power plants: Final report.** Bolten, J.G.; Morrison, P.F.; Solomon, K.A. (RAND Corp., Santa Monica, CA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Aug 1987. 394p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920548.

This report describes the development and application of a methodology for assessing the control costs and chronic health risks of toxic pollutant emissions from coal-fired electric power plants. The approach emphasizes surface water discharges and pollution, but incorporates emissions to air, water, soil, and groundwater and transfers of pollutants between these media. The components of the general framework include (1) pollutant emission characterization, (2) environmental transport and fate analysis, (3) population exposure calculation, and (4) quantitative health risk assessment. The report provides a basic overview of the approach, discusses each component in detail, and describes its application to an hypothetical, simplified case study. 234 refs., 32 figs., 32 tabs.

42262 (IAEA-TECDOC—406) **Radiotracer studies of agrochemical residues in meat, milk and related products of livestock and poultry. Report of a research co-ordination meeting on studies of agricultural chemical residues in meat, milk and related products of livestock with the aid of nuclear techniques held in Belgrade, 16-19 July 1986.** (Joint FAO/IAEA Div. of Isotope and Radiation Applications of Atomic Energy for Food and Agricultural Development, Vienna (Austria)). Jan 1987. 95p. (CONF-8607333—Summ.). NTIS (US Sales Only), PC A05/MF A01. File Number DE87702735.

From Research co-ordination meeting on studies of agricultural chemical residues in meat, milk and related products of livestock with the aid of nuclear techniques; Belgrade, Yugoslavia (16 Jul 1986).

The joint FAO/IAEA programme was initiated in 1981 and terminates with this report. The specific objectives of the programme have been to evaluate the magnitude, fate and significance of agricultural chemical residues in edible tissues and by-products of livestock and poultry, aided by radiotracer techniques. It was anticipated that the data arising from studies conducted under this programme would be useful in assessing the toxicological significance of studied chemicals to exposed animals and to humans who may consume potentially polluted meat, milk or eggs. A separate abstract was prepared for each of the 13 papers in this report.

42263 (IAEA-TECDOC—406, pp 9-13) **/sup 14/C-coumaphos residues in Egyptian lactating goats.** Osman, A.Z.; Zayed, S.M.A.D.; Hazzaa, N.I. (Middle Eastern Regional Radioisotope Centre for the Arab Countries, Cairo, Egypt). Jan 1987. NTIS (US Sales Only), PC A05/MF A01. File Number DE87702735. (CONF-8607333—Summ.).

From Research co-ordination meeting on studies of agricultural chemical residues in meat, milk and related products of livestock with the aid of nuclear techniques; Belgrade, Yugoslavia (16 Jul 1986).

/sup 14/C-coumaphos was applied dermally to two lactating goats, with 2 weeks interval. One goat was sacrificed 24 hours after the second application, and the second animal after a withdrawal period of two weeks. The results showed that coumaphos has a slow penetration rate when dermally applied to lactating goats. Milk residues were 0.20-0.25 ppm following appication, declining gradually to 0.03-0.06 ppm after 2 weeks. The liver and kidney were found to contain considerable amounts of coumaphos residues in comparison with other organs and milk after the withdrawal period. 5 refs, 2 tabs.

42264 (IAEA-TECDOC—406, pp 15-20) **Fate and metabolism of radiolabelled monocrotophos in Egyptian lactating goats.** Osman, A.Z.; Zayed, S.M.A.D.; Hazzaa, N.I. (Middle Eastern Regional Radioisotope Centre for the Arab Countries, Cairo, Egypt). Jan 1987. NTIS (US Sales Only), PC A05/MF A01. File Number DE87702735. (CONF-8607333—Summ.).

From Research co-ordination meeting on studies of agricultural chemical residues in meat, milk and related products of livestock with the aid of nuclear techniques; Belgrade, Yugoslavia (16 Jul 1986).

Lactating goats receiving two dermal applications of /sup 14/C-monocrotophos sprayings did not show any adverse effects related to pesticide applications. Under conditions simulating those of agricultural practice, residues were secreted in milk at a concentration of 0.13 ppm after the first day; declining to 0.02 ppm on the fifth day and to non-detectable levels on the 7th day. The hair and skin contained the highest concentration. In most edible organs, residue levels were generally low following the second application and declined rapidly after a 14-day withdrawal period to levels ranging from trace to 0.04 ppm. The insecticide inhibited both plasma erythrocyte cholinesterase activity significantly one day after application. Slow recovery could be observed during the 14-day withdrawal period. 4 refs, 1 fig, 3 tabs.

42265 (IAEA-TECDOC—406, pp 21-27) **Fate of /sup 14/C-monocrotophos in lactating goats.** Qureshi, M.J.; Jamil, F.F.; Ul-Haq, A.; Naqvi, S.H.M. (Nuclear Inst. for Agriculture and Biology, Faisalabad, Pakistan). Jan 1987. NTIS (US Sales Only), PC A05/MF A01. File Number DE87702735. (CONF-8607333—Summ.).

From Research co-ordination meeting on studies of agricultural chemical residues in meat, milk and related products of livestock with the aid of nuclear techniques; Belgrade, Yugoslavia (16 Jul 1986).

/sup 14/C-monocrotophos was fed daily to two groups of lactating goats for five days at 5 and 10 mg per goat per day. The radioactivity in urine and faeces accounted for 50% and 7%, respectively, 24 hours after the first dose. About 25% of the radiocarbon was found in various organs. About 1-2% of the administered radiocarbon was secreted in milk. It was concluded that monocrotophos was rapidly eliminated through urine and faeces of teddy goats. /sup 14/C-residues in milk and urine were tentatively identified as monocrotophos, dimethylphosphate and N-desmethyl monocrotophos. The erythrocyte cholinesterase activity was reduced to 50% 24 hours after treatment, but no toxic symptoms were observed. 13 refs, 4 tabs.

42266 (IAEA-TECDOC—406, pp 29-35) **Fate of /sup 14/C-carbofuran in lactating goats.** Tejada, A.W.; Magallona, E.D. (University of the Philippines, Los Banos. College of Agriculture). Jan 1987. NTIS (US Sales Only), PC A05/MF A01. File Number DE87702735. (CONF-8607333—Summ.).

From Research co-ordination meeting on studies of agricultural chemical residues in meat, milk and related products of livestock with the aid of nuclear techniques; Belgrade, Yugoslavia (16 Jul 1986).

Radiocarbon labeled carbofuran was administered orally to lactating goats at 0.03 mg/kg (single dose), 0.5 and 1.0 mg/kg/day for 7 days, and at 5.0 ppm in the diet (2 kg feed intake/day basis) for 15 days. Radioactive residues were rapidly excreted in the urine after treatment. The major residue identified in urine of the treated goats was carbofuran phenol, a non-toxic metabolite. Only about 1% of the doses was eliminated in the feces of the treated goats. Residues of (/sup 14/C)carbofuran were secreted into milk, but these residues were in all cases very low. Radioactive residue occurred in tissues at low levels, with patterns as follows: omental fat>liver>subcutaneous fat>kidney>brain>heart>biceps femoris>longissimus dorsi. The residue stored in fat was identified as carbofuran. The liver contained hydroxy carbofuran and one unidentified metabolite but no carbofuran. The other tissues contained only phenolic metabolites. These studies strongly indicate that proper carbofuran use in rice in the Philippines will present no risks to goats that consume treated crop residues, or to humans who consume meat or milk from exposed animals. 13 refs, 2 figs, 4 tabs.

42267 **(INIS-mf—10882) Effect of parathion on the synthesis of DNA, RNA and protein in the primary erythrocytes, and on the nervous system differentiation in chick embryo.** Osman, Mohammad. (Atomic Energy Commission, Damascus (Syria)). 1986. 31p. (In Arabic). NTIS (US Sales Only), PC A03/MF A01. File Number DE87702782.

In the experiments, chick embryos between the primitive streak stage and the 6-somites stage were used. These embryos were cultured in vitro, with the presence of Parathion for 12, 24, 36 hours. The result showed that Parathion has a teratogenic effect on the early stages of embryogenesis. Morphological and histological changes in brain, embryonic axis, heart mesenchyme and erythrocytes were found. Parathion's effect at molecular level quantitatively and qualitatively was studied, using autoradiography and radioactivity measurements after incorporation of ^{3}H thymidine, ^{3}H uridine and ^{3}H delta amino levulinic acid. An inhibitory effect of Parathion on the synthesis of DNA, RNA and hemoglobin was shown. The inhibitory ratio increases with the increase of exposure period to Parathion. These results suggested that Parathion affects other mechanisms which have no relation with acetylcholinesterase activity. This activity was inhibited in a more advanced stages by Parathion.

42268 **(Juel-Spez—381) Methods to evaluate ecotoxicological effects of chemicals. Vol. 8. Membranes as biological indicators. Report: 1981-1985.** Scheele, B.; Verfondern, M. (eds.). (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Projekttraeger Biologie, Oekologie, Energie). Nov 1986. 96p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE87770228.

Since 1978 the Minister for Research and Technology has supported research activities dealing with ecotoxicology. In this report the results of four research projects are presented. These are founded within the project 'Methods to Evaluate Ecotoxicological Effects of Chemicals'. In cooperation three groups investigated the effects of potentially ecotoxic 'reference chemicals' on passive and active membrane properties of plant cells. On this basis practically applicable test systems had been developed: A simple qualitative test which is applicable in the field and where cells immobilized in alginate beds indicate acute toxic concentrations of chemicals. And a simple quantitative test where pollutant chemicals elicit passive and unspecific efflux of electrolytes from plant storage tissue slices. The cell rotation-test uses the electric properties of membranes. In a fourth, independent project an ultra-fine glass electrode was tested that allows to monitor the negative influence on biomembrane functions of toxic concentrations of chemicals by measuring changes in cytoplasmic pH in vacuoles and on cell surfaces.

42269 **(LBL—23629) Density-equalizing map transformations in environmental health applications.** Merrill, D.W. Jr. (Lawrence Berkeley Lab., CA (USA)). May 1987. Contract AC03-76SF00098. 7p. (CONF-8705147—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012883.

From Piecing the puzzle together: a conference on integrating data for decisionmaking; Washington, DC, USA (27 May 1987).

In a density-equalized map, or cartogram, an ordinary geopolitical map is transformed to make the areas of individual subareas proportional to population. As a display tool, such a map is visually meaningful for population-based data, for example death rates. More important, using density-equalized projections one can analyze geographic distributions events which are so infrequent that reliable rates cannot be calculated for individual subareas. Statistically significant non-uniformity of cases on the transformed map implies significant non-uniformity of rates on the original map. A computer algorithm for density-equalizing projections has been developed by the author and used in various environmental health applications. 13 refs., 6 figs.

42270 **(NP—7770225) Investigations into the physiology of gas exchange under constant conditions on twigs of spruces of different ramification types and different geographic provenance and on twigs of spruces damaged by immissions from the Black Forest and Fichtel mountains.** Guo Liansheng. (Freiburg Univ. (Germany, F.R.). Forstwissenschaftliche Fakultaet). 1984. 110p. (In German). NTIS (US Sales Only), PC A06. File Number DE87770225.

The object of this investigation was to contribute towards better understanding of production conditions in the crowns of both healthy and diseased spruces. The following individual problem complexes were investigated: a) Gas exchange in spruces in plains and ridges as measured in lateral branches from different crown heights, b) Gas exchange of slowly and rapidly growing spruces of different geographic provenance as measured in lateral branches of the same twirl, c) Gas exchange of spruces from the Black Forest and Fichtel mountains damaged by immissions. The following quantities were measured: Net photosynthesis, water uptake of branches, repiration of branches and shoots after needleloss in the dark, respiration in light, CO/sub 2/ compensation point, needle temperature and conductivity of the needles for water vapour. Bases of reference used were the dry weight, the fresh weight of branches saturated with water, and the needle surface.

42271 **(NP—7770232) Interactions between lead, zinc, and cadmium as determined by an epidemiological investigation of selected heavy metal levels in blood.** Kuhrt, O.W. (Technische Hochschule Aachen (Germany, F.R.). Medizinische Fakultaet). 10 Sep 1985. 150p. (In German). NTIS (US Sales Only), PC A07. File Number DE87770232.

Corresponding to literature, higher blood levels of lead are found in adults as against children, and in males as against females. Smokers show higher blood levels of lead compared to non-smokers. Based on the heavy metal concentrations in the blood, no correlation can be established between the intensity of emission inputs and disorders of the respiratory tract and allergic symptoms. However, smokers frequently reveal an increased occurrence or signs of chronic bronchitis. The blood level of lead in children depends from their social status. Children from the lowest socio-economic stratum reveal higher lead blood levels. The same goes for cadmium. Tonsillectomized children reveal higher lead values as against other children. In adults, lead blood levels are higher in hypertensive persons than in normotensive ones. Adults from the exposure area show markedly higher lead levels in their blood than those from the control area. By contrast, children in the exposure area show markedly lower lead blood levels than those living in the control area. The same applies to cadmium values whereas the reverse is true for zinc. Based on these and other findings, an antagonistic action is suggested to exist between lead and zinc, and between cadmium and zinc. In addition, there are signs of a synergistic action of lead and cadmium.

42272 **(NP—7770235) Effects of air pollutants on man's health.** Kloiber, G. (Muenchen Univ. (Germany, F.R.). Fakultaet fuer Medizin). 18 Jul 1985. 295p. (In German). NTIS (US Sales Only), PC A13. File Number DE87770235.

This is a study on smog which looks into the relationships between air pollution and acute respectively chronic diseases. For this purpose a compilation of literature was carried through. A literature analysis is to document the current state of knowledge on the effects of air pollution. To the literature study certain criteria

were applied. Subjects, methodics, and discussion of results were particularly taken into account. The literature evaluation comprises the summarizing of contents and juxtaposition of results.

42273 **(NP—7770238) Individual and combined effects of zinc and cadmium on the growth, physiology and morphology of Euglena gracilis.** Ruge, W.A. (Technische Univ. Muenchen, Garching (Germany, F.R.). Fakultaet fuer Chemie, Biologie und Geowissenschaften). 2 Dec 1983. 182p. (In German). NTIS (US Sales Only), PC A09. File Number DE87770238.

The effects observed in photoautotrophic cultures with a zinc deficiency are similar to the effects in heterotrophic and photoheterotrophic cultures. The symptoms of zinc deficiency are not ameliorated by glutamine. Glutamine was used as a carbon source both in case of normal zinc supply and in case of zinc deficiency also in the light. The chlorophyll concentration in the cell decreased in this case, and photosynthesis was no longer observable. The morphology of the cell organella was not affected by the zinc deficiency. The effects of different zinc concentrations on the growth of Eugenia gracilis were typical of an essential trace element. At normal zinc concentration, Cd concentrations of 0.05 μM were already toxic. Growth, photosynthesis and cellular respiration were inhibited to the same degree by 0.1 μM Cd. While 0.1 μM Cd was clearly toxic at normal zinc supply, in case of zinc deficiency they enhanced both growth and oxygen exchange. Also the cell composition and the energy status were modified in the direction of normal zinc supply. Higher Cd concentrations did not enhance growth but increased the growth inhibition in case of zinc deficiency, especially with a view to a long lag phase. The combined effects of increased zinc and cadmium concentrations differed as a function of concentrations, time of growth, and selected parameters. Morphologically different cell types had different sensitivities to damaging heavy metal effects. The number of mobile cells decreased with the zinc and cadmium concentration. Zinc and cadmium concentrations were in the range normally occurring in polluted rivers.

42274 **(ORNL—6356) Water quality criteria for Disperse Red 9: Final report.** Davidson, K.A.; Hovatter, P.S. (Oak Ridge National Lab., TN (USA)). Jul 1987. Contract AC05-84OR21400. 87p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87012679.

The available data on the environmental fate, aquatic toxicity, and mammalian toxicity of Disperse Red 9 (1-methylaminoanthraquinone), an organic dye used in pyrotechnic smoke signals, were reviewed. Disperse Red 9 is insoluble in water and exhibits negligible volatility, indicating that environmental dispersal should be minimal. An environmental fate model predicts that the dye would primarily accumulate in water. Limited information is available concerning the transport, transformation, or degradation of Disperse Red 9 in the environment. The dye will undergo photodecomposition. Transformation combustion is by oxidation to 1-aminoathraquinone and 2-aminoanthraquinone. Although Disperse Red 9 is absorbed from the gastrointestinal tract, it has only mild acute and subchronic oral toxic effects in laboratory animals. It has no dermal toxicity in laboratory animals, but in humans it causes dermal irritation and delayed hypersensitivity reactions. Disperse Red 9 causes mild toxic effects in humans exposed orally or by inhalation. Acute inhalation exposure in rodent and nonrodent species causes nasal irritation, salivation, gagging, regurgitation, dyspnea, and death, depending on the dose and duration of exposure. In genotoxicity tests, Disperse Red 9 is negative in Salmonella typhimurium, positive in mouse lymphoma cells in the presence and absence of S9, and positive in unscheduled DNA synthesis assays only in the presence of S9. 56 refs., 7 tabs.

42275 **(PB—87-189825/XAB) Polycyclic aromatic hydrocarbon hazards to fish, wildlife, and invertebrates: a synoptic review.** Eisler, R. (Patuxent Wildlife Research Center, Laurel, MD (USA)). May 1987. 93p. (BIOLOGICAL—85(1.11)). NTIS, PC A05/MF A01.

The report synthesizes technical literature on ecological and toxicological aspects of polycyclic aromatic hydrocarbons (PAH) in the environment, with special reference to fisheries and wildlife resources. Subtopics include: chemical properties, sources, and fate; background concentrations in biological and nonbiological samples; toxic and sublethal effects of PAH to flora and fauna; proposed criteria and research needs for the protection of sensitive, nonhuman organisms.

42276 **(PB—87-191706/XAB) Determination of absorbed dose of ozone (O_3) in animals and humans using stable-isotope (oxygen-18) tracing.** Hatch, G.E.; Aissa, M. (Northrop Services, Inc., Research Triangle Park, NC (USA)). May 1987. 26p. NTIS, PC A03/MF A01.

A method for the determination of absorbed dose of ozone (O_3) in animals and humans using oxygen-18 ^{18}O as a physiological tracer is presented. The experimental aspects of the method are based on the instantaneous pyrolysis of tissue samples and subsequent conversion of the sample oxygen to carbon monoxide then to carbon dioxide whose isotopic composition is determined by isotope-ratio mass spectrometry. A mathematical procedure is then used to correct the isotopic data for interferences from the blank and memory effects and from the iodine pentoxide oxidation of CO to CO_2. Laboratory animals were exposed to $^{18}O_3$ (1 ppm, 1 hr) then tissues were dried and processed for ^{18}O measurement. Enrichments in ^{18}O over natural abundance ^{18}O was observed in lung homogenates, nasal cavities, trachea, and pulmonary lavage fluids but not in blood of mice, rats, and rabbits. Thus, the ^{18}O tracing method appears to be sensitive enough to detect the reaction products of ^{18}O in animals exposed to near environmental concentrations of this gas.

42277 **(PB—87-196184/XAB) Health significance of pulmonary function tests.** Lippmann, M. (New York Univ., NY (USA). Inst. of Environmental Medicine). Jun 1987. 18p. NTIS, PC A02/MF A01.

As the sensitivity and precision of functional tests improve, we become increasingly able to measure responses to pollutant exposures with little, if any, demonstrable health significance. Proper interpretation of such functional responses generally requires an ability to evaluate them in the context of a larger body of knowledge of biochemical, toxicological, morphometric, and pathological effects data for the particular pollutant following various short- and long-term exposures. There are few, if any, generic rules or guidelines for interpreting the significance of functional responses to air pollutants at this time, especially when their magnitude is small and they are transient. This paper presents brief descriptive summaries of functional tests that can be used for characterizing pollutant responses in field and laboratory studies, and discusses how such responses can be examined for their health significance. The specific pollutants discussed are SO_2, NO_2, O_3, and H_2SO_4. The scientific and ethical limitations of epidemiologic, laboratory, and animal studies are discussed.

42278 (PNL—6100-Pt.1, pp 53-56) **Mutagenicity of complex chemical mixtures.** Pelroy, R.A. Feb 1987. NTIS, PC A06/MF A01. File Number DE87010024.

In Pacific Northwest Laboratory: annual report for 1986 to the DOE Office of Energy Research: Part 1, Biomedical Sciences.

Mutational synergism was demonstrated between highly aromatic chemical mixtures and several classes of mutagens, including amino polycyclic aromatic hydrocarbons (amino-PAH), nitroaromatic hydrocarbons (NO_2-PAH), and the DNA intercalating agent ICR191. For amino-PAH, synergism was partly due to differential effects on rate of degradation versus activation by P450/448 metabolizing enzymes. Synergism was observed at comparatively low concentrations of the complex mixtures (5-20 μg/ml exposure medium), where the mixtures were in excess (200- to 500-fold) on a weight/weight mixture-to-mutagen basis. For several amino-PAH, complex chemical mixtures also lowered the apparent threshold concentration of the amino-PAH capable of inducing mutagenesis. Complex mixtures capable of interacting synergistically with amino-PAH, NO_2-PAH, and ICR191 failed to stimulate, or slightly inhibited, the mutagenic potential of benzo[a]pyrene. 4 figures.

42279 (PNL—6100-Pt.1, pp 57-63) **Complex mixtures biostudies.** Springer, D.L. Feb 1987. NTIS, PC A06/MF A01. File Number DE87010024.

In Pacific Northwest Laboratory: annual report for 1986 to the DOE Office of Energy Research: Part 1, Biomedical Sciences.

The objective of the project is to identify potential adverse biological activities associated with human exposures to complex organic mixtures (COM) from energy-related industries. Studies to identify the influence of chemical class fractions from a COM on the initiating activity of a known carcinogen, benzo(a)pyrene (BaP), demonstrated that the polycyclic aromatic hydrocarbons (PAH) and nitrogen-containing polycyclic aromatic compound (NPAC) fractions were the most effective inhibitors of initiation. In an effort to determine the contribution of BaP to the initiating activity of the COM, binding of radiolabeled BaP to mouse skin DNA was measured. Results indicated that binding of BaP to DNA decreased in the presence of the COM so that at initiating COM doses, BaP binding was near the limit detection. Addition of unlabeled BaP to the COM at an amount similar to that originally present in the COM did not significantly increase the binding. Studies to determine the rates of disappearance of carcinogenic PAH from the site of application on the skin indicated that half-lives for PAH differed by a factor of about 2. Analytical methods developed to identify PAH from COM which covalently bind to DNA demonstrated that the lower level of detection is approximately 200 picograms. Developmental studies demonstrated that both pregnant rats and mice treated dermally with a high-boiling COM developed fetuses with major malformations including cleft palate, small lungs, edema, and sagittal suture hemorrhages. 3 figures, 5 tables.

42280 (PNL—6100-Pt.1, pp 71-73) **Perinatal effects of complex mixtures.** Springer, D.L. Feb 1987. NTIS, PC A06/MF A01. File Number DE87010024.

In Pacific Northwest Laboratory: annual report for 1986 to the DOE Office of Energy Research: Part 1, Biomedical Sciences.

To study the effects of complex organic mixtures (COM) as promoters of preneoplastic changes in rat liver, it was necessary to develop dose-response information for initiation by diethylnitrosamine (DEN). For this purpose, 1-day-old rat pups were injected with either 4, 8 or 16 μg DEN/g body weight and promoted by twice-weekly applications of a COM beginning at 3 weeks of age. Liver samples collected after 8 weeks of promotion were analyzed for foci of phenotypically changed cells by exclusion of iron and/or increased gamma glutamyl transpeptidase (GGT) activity. Results indicate that female rats were more sensitive to COM promotion than males and that the number of altered foci increased with larger doses of DEN. At higher DEN doses the phenotypic alterations did not require promotion, indicating that the changes were induced by DEN initiation alone. Furthermore, the greatest number of phenotypic changes involved foci of cells which either stained positive for GGT activity, or stained for GGT and excluded iron. These results demonstrate that female rats are preferable for studies using this assay system and that the selection of the DEN initiator dose is critical. 2 tables.

42281 **(PNL-SA—13184) Breath analysis as a technique for complex-mixture dosimetry measurements.** Weimer, W.C.; Zangar, R.C.; Springer, D.L. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1986. Contract AC06-76RL01830. 13p. (CONF-861044—9). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012171.

From Hanford Life Sciences symposium: radiation protection-a look to the future - celebrating four decades of research at Hanford; Richland, WA, USA (21 Oct 1986).

The time course of blood and breath concentrations was determined for a series of one-, two-, and three-ring polycyclic aromatic hydrocarbons and substituted PAH of increasing polarity following exposure by intraperitoneal injection. We then calculated breath/blood partition coefficients for each compound. Equilibrium was established in less than 4 hr for all compounds after injection. One-ring PAH cleared from the system within 24 hr after exposure; larger-ring-size compounds had not cleared by 24 hr. The magnitude of the partition coefficients for this series of five PAH ranges from about 0.2 for benzene to 1 x 10^{-6} for phenanthrene. These data suggest that breath collection and analysis may be useful for evaluating short-term exposure (from 1 day for the smallest compounds to a few days for larger compounds) to chemically complex mixtures. 7 refs., 3 tabs.

42282 **(PNL-SA—13188) Effects of complex organic mixtures of coal liquid on cardiovascular function in the rat.** Sasser, L.B.; Zangar, R.C.; Springer, D.L.; Mahlum, D.D. (Pacific Northwest Lab., Richland, WA (USA)). Jun 1987. Contract AC06-76RL01830. 13p. (CONF-851027—13). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012163.

From 24. Hanford life sciences symposium and environmental research on complex organic mixtures; Richland, WA, USA (20 Oct 1985).

We evaluated the effects of high-boiling coal liquids on the rat cardiovascular system. In two studies, rats were exposed to coal-derived heavy distillate (HD), via inhalation, for 6 hr per day, 5 days per wk for 6 wk. The HD produced high blood pressure, without affecting electrocardiogram patterns, in rats exposed to air concentrations of 0.7 mg/L and 0.24 mg/L. After 6 wk recovery, blood pressure was not statistically different among groups. We also observed significant changes in other cardiovascular measurements, including increases in plasma volume, blood volume, blood PCO_2, plasma cholesterol and high-density lipoprotein, and decreases in plasma angiotensin levels. In a third study, blood pressures of rats exposed to HD were elevated after dermal application, but not after gavage. 14 refs., 9 figs., 1 tab.

42283 **Evaluation of the kriging method to predict 7-h seasonal mean ozone concentrations for estimating crop losses.** Lefohn, A.S.; Knudsen, H.P.; Logan, J.A.; Simpson, J.; Bhumralkar, C. (A.S.L. & Associates, Helena, MT). *Journal of the Air Pollution Control Association;* **37**: No. 5, 595-602(May 1987).

Using kriging, a statistical technique, the National Crop Loss Assessment Network (NCLAN) program estimated growing season 5-month (May-September) ambient 7-h mean O_3 concentrations for each of the major crop growing areas of the US for 1978-1982. The O_3 estimates were used to predict economic benefits anticipated by lowering O_3 levels in the US. This paper reviews NCLAN's use of kriging to estimate 7-h seasonal mean O_3 concentrations for crop growing regions. Although the original kriging program used by NCLAN incorrectly calculated the diagonal elements of the kriging equations, this omission did not result in significant errors in the predicted estimates. Most of the data used in estimating the 7-h seasonal values were obtained from urban areas; the use of these data tended to underestimate the 7-h seasonal O_3 concentrations in rural areas. It is recommended that only O_3 data that are representative of agricultural areas and have been collected under accepted quality assurance programs be used in future kriging efforts.

42284 **(LA-tr—87-10) Injuries caused by optic irradiation and heat from RSV warheads.** Weibull, G.W. (Los Alamos National Lab., NM (USA)). 12 Feb 1987. Contract W-7405-ENG-36. Translation of FFV Technical report, CFT 126-09:105, 2nd ed. 41p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87012688.

When combatting warfare vehicles with armor piercing ammunition of RSV-type injuries can be caused by optic irradiation, hot gases and hot splinters. Primarily, the vision is affected, in part due to flash blindness, in part due to injuries to the retina. In addition here is a risk for skin burns. Injury criteria for such effects have been formulated. Flammable materials (fuel, oil, fabrics, etc.) catching fire pose a certain risk. Time only permitted a listing of the literature concerning that field. Some statements rest on a weak foundation. Further research and investigations are required. Such study areas are indicated in a special chapter. 58 refs., 2 figs., 7 tabs.

42285 **Forest decline research at the Oak Ridge National Laboratory.** McLaughlin, S.B. (Oak Ridge National Lab., TN, USA). pp 112-113 of Forest decline. Research into the causes of forest decline in West Germany and the USA. Papke, H.E.; Krahl-Urban, B.; Peters, K.; Schimansky, C. (comps.). Juelich, Germany, F.R.; Kernforschungsanlage (1986). (In German)

The effect of air pollutants on forest trees is prooved at the Oak Ridge National Laboratory, U.S.A. Productivity and accumulation of elements as aluminium, cadmium, zinc and manganese was

determined. It could be shown, that generally the productivity is diminishing and that the trees damages and their contents of toxic elements are getting greater with increasing air pollution.

42286 **Research area: Walker Branch Watershed (Tennessee). Elemental flow in forest ecosystems.** Lindberg, S.E. (Oak Ridge National Lab., TN, USA). pp 114-115 of Forest decline. Research into the causes of forest decline in West Germany and the USA. Papke, H.E.; Krahl-Urban, B.; Peters, K.; Schimansky, C. (comps.). Juelich, Germany, F.R.; Kernforschungsanlage (1986). (In German)

At the research area Walker Branch Watershed, USA, the effect of air pollutants as mercury dioxide, nitrogen and heavy metals on forest ecosystems was prooved. It could be shown, that besides the wet deposition dry deposition of these pollutants is very important and enduringly changes forest ecosystems.

5604 Other Environmental Pollutant Effects

REFER ALSO TO CITATION(S) 42180

42287 **(AD-A—180300/6/XAB) Occurrence of hearing loss in a cohort of civilians employed at a US Navy industrial facility. Interim report.** Helmkamp, J.C.; Bone, C.M.; Blood, C.G.; Kelley, J.B.; Seidman, J.H. (Naval Health Research Center, San Diego, CA (USA)). 18 Dec 1986. 17p. (NHRC—34). NTIS, PC A02/MF A01.

Although hearing loss has been the focus of national surveys in the civilian population, these surveys typically do not include occupational exposure information. Furthermore, very few studies have addressed this problem in the military, particularly in industrial settings. Audiometric data, including hearing loss information, recorded and stored in the prototype application of the Navy's Occupational Health Information Management System (NOHIMS) has not been systematically evaluated to identify military and civilian populations that are at high risk for hearing loss. The objective of this study was to determine the prevalence of hearing loss in a cohort of Navy civilian workers employed at an industrialized facility. It is both appropriate and timely to look at hearing loss among civilian workers, as well as among the military, especially in relation to the recent Presidential initiative that established a government-wide five year goal of reducing civilian workplace injury/illness 3% per year.

42288 **(AD-A—180576/1/XAB) Nonauditory effects of repeated exposures to intense impulse noise.** Phillips, Y.Y.; Dancer, A.; Richmond, D.R. (Walter Reed Army Inst. of Research, Washington, DC (USA). Div. of Medicine). 1986. 12p. NTIS, PC A02/MF A01.

Pub. in Basic and Applied Aspects of Noise-Induced Hearing Loss, 489-500(1986).

Exposure to intense impulse noise can cause injury to all of the air-containing structures of the body. While the ear is the most-sensitive organ, the upper respiratory tract (URT), the lungs, and the gut can be damaged by air blast. This nonauditory injury has been studied as a consequence of weapon-effects research. The development of light, long-range artillery and powerful shoulder-fired antitank weapons has increased the intensity of impulse noise to which soldiers are exposed. Hearing damage is recognized as a military occupational health hazard, and the advent of louder weapons has raised the possibility that nonauditory injury might become a limiting safety concern. Animal research was begun in Europe and the United States in an attempt to define that new hazard. Anesthetized sheep and swine were necropsied after being exposed to a variety of impulse conditions. It was readily demonstrated that with repeated exposures, nonauditory injury could build up at relatively low overpressure levels.

58 GEOSCIENCES

5801 Geology And Hydrology

REFER ALSO TO CITATION(S) 40399, 40545, 40556, 40668, 40731, 41431, 42011

42289 **(DOE/NV/10322—22-Vol.8) Lithology and stratigraphy of drill holes completed during 1986 in LANL [Los Alamos National Laboratory] use areas of Yucca Flat, Nevada Test Site: Volume 8.** Cavazos, A.P.; Drellack, S.L. Jr.; Hughes, W.T.; Thompson, P.H. (Fenix and Scisson, Inc., Mercury, NV (USA)). Apr 1987. Contract AC08-84NV10322. 202p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE87012985.

This report is a compilation of data from drill holes completed during the calendar year 1986 in areas used by Los Alamos National Laboratory in Yucca Flat, Nevada Test Site. Data presented in this report include hole locations, drilling statistics, a supplemental data sheet, stratigraphy and lithology penetrated, and selected geophysical logs including a log of drilling penetration rate. Lithologic description and stratigraphic identification of the Tertiary volcanic rocks are emphasized.

42290 **(NAGRA-NTB—84-16) Fluviatile erosion and accumulation forms as indication of Young Pleistocene and Holocene movements in Northern Switzerland and adjacent regions.** Haldimann, P.; Naef, H.; Schmassmann, H. (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Aug 1984. 119p. (In German). Nagra, CH-5401 Baden, Switzerland.

The present report contains the results of a study made in order to find geological evidence for Pleistocene and Holocene tectonic movements in northern Switzerland and neighbouring areas. In the first part, a study of the subcrop-morphology and a comparative analysis of accumulation- and erosion-terraces is presented in order to find indices for Pleistocene and Holocene movements in the northern Aare valley. There is evidence for a regional tilting movement, with relative uplift in the south (area around Brugg and folded Jura eventually) and down-dip in the north (Rhine-line). Furthermore there are arguments to suspect Pleistocene and Holocene uplifting along the Mandach-fault and along an anticline striking SW-NE through Klingnau. The second part is a discussion about the geological and geomorphological arguments for movements of the crust in the valley of the Upper Rhine between Toessegg and Basle during the Late Pleistocene and the Holocene. In this area there are neotectonic lines which usually keep distances of 3 to 8 km. Between them the blocks have been rigid at least since the Riss/Wuerm Interglacial. The differential velocities of the movements are about 0.1 - 0.2 mm a year. However on several neotectonic lines the indicated movements already ended during the Late Pleistocene. In the third part the courses and the longitudinal gradients of the Black Forest rivers flowing into the Upper Rhine as well as their tributaries are examined referring to neotectonic indications. This goes to prove that various movements of the crust occured during the whole Quarternary. For example the Hotzenwald directly neighbouring to the valley of the Upper Rhine in the north was uplifted and tilted after the Riss Glaciation.

42291 **(NAGRA-NTB—84-25) Key for the Geological Map of Central Northern Switzerland.** Mueller, W.H.; Huber, M.; Isler, A.; Kleboth, P. (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Dec 1984. 247p. (In German). Nagra, CH-5401 Baden, Switzerland.

A new geological map on a scale 1:100000 is presented, covering the central part of Northern Switzerland and the adjoining regions of Baden -Wuerttemberg. This map, a co-production of the NAGRA and the Swiss Geological Commission is a compilation of about 350 different maps and sketches, partly unpublished or out of print for a long time. The explanatory text gives a popular review of the geological and tectonical history of the region and a short description of the main rock units. New results of the NAGRA research program, including deep drillings and studies in Neotecton-

ics, have been incorporated. The report is illustrated with numerous block diagrams, various key maps and coloured cross sections.

42292 **(NAGRA-NTB—84-28) Evaluation of satellite-image lineaments of the area Baden - Frick -Laufenburg - Zurzach.** Isler, A. (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Aug 1984. 30p. (In German). Nagra, CH-5401 Baden, Switzerland.

Satellite images often show a dense network of linear elements. The effective meaning of these lineament patterns is still under discussion, especially as to their significance in structural interpretations. In northern Switzerland, a detailed comparison of Landsat images with topographic and geological maps, and aerial photographs - all on a scale of 1 : 25000 - has proved that most of the lineaments delinated in Landsat images appear to represent bright/dark contrasts produced by morphology, vegetation and human activity. No conclusive evidence as to tectonic origins were observed. Nevertheless, tectonically influenced origins of recent drainage patterns cannot be neglected. However, the evaluation of potential repository sites in northern Switzerland must be based on detailed field work whereas tectonic lineament pattern derived from satellite images should be considered only as informations of secondary or supplementary importance.

5802 Geophysics

REFER ALSO TO CITATION(S) 40554

42293 **(CEA-CONF—8817) Provence earthquake of 11th June 1909 (France). 1. A new assessment of near field effects.** Levret, A.; Loup, C.; Goula, X. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). Oct 1986. 19p. (CONF-8609300—1). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752532.

From 8. European conference on earthquake engineering; Lisbon, Portugal (7 Sep 1986).

The earthquake which took place on June 11, 1909 in the vicinity of Lambesc in Provence was the largest one this century in France (Io = IX). The discovery of an unpublished document (Spiess 1914) containing a very detailed description of the effects at 809 points in the epicentral area (geological and topographical characteristics, description of the buildings and the damage incurred, as well as the description of each seismic shock felt and the direction of ground motion), has made it possible to draw up an isoseismal map, to correlate local variations in intensity with the geological and topographical features, to determine a focus situated in the post-Triassic covering at a depth of less than 5 km, and to draw a map of the directions of the ground motion which will be used to identify the source mechanism, covered in another study.

42294 **(CEA-DAS—284) Provence seism on the 11th of June 1909. Analysis of unpublished documents of Commandant Spiess. Interpretation of macroseismic observations.** Levret, A.; Loup, C.; Goula, X. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). Sep 1986. 140p. (In French). NTIS (US Sales Only), PC A07. File Number DE87752534.

This report studies the Provence seism of the 11th of june 1909, from a document of commandant Spiess. This impressive document has been written in 1909: it includes in the damage zone, numerous and very detailed descriptions on building damages, on the way the shock has been felt, on movement direction, on geologic and topographic characteristics of places where observations have been made. First this document has been carefully analysed, observations have been interpreted and compared with other data sources. Results modify and complete data currently available on this seism. In a second part, detailed macroseismic observation of epicenter region have been tentatively interpreted. Influence on damages of factors related to wave propagation at source mechanism has so been shown.

42295 **(DOE/ER/13413—2) Volcanological investigation of the Banco Bonito eruption and subsurface geology of the ring fracture zone, Valles Caldera, New Mexico: Final technical report, September 1, 1985-December 31, 1986.** Self, S.; Wolff, J.; Kircher, D. (Texas Univ., Arlington (USA). Dept. of Geology). Mar 1987. Contract FG05-85ER13413. 84p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87011192.

A low-silica rhyolite eruptive sequence of 3 to 4 km^3 (dense rock equivalent volume) forms the youngest volcanic event from the ring-fracture of the Valles caldera. $^{230}Th/^{232}Th$ - $^{238}U/^{232}Th$ activity ratios determined for whole rock, glass, and mineral phases indicate that the magma system became closed isotopically ~150 Ka. Other evidence from age dating supports an age for the eruption between 150 and 130 Ka. This event was of considerable duration with plinian and ignimbrite-forming activity preceding an effusive phase by a lengthy, but indeterminable, interval. The lava flow was emplaced onto a much-dissected surface cut into the El Cajete and Battleship Rock pyroclastic deposits. Twenty-four bulk-rock samples from all 3 eruptive stages exhibit little significant compositional variation, and the 3 units are petrographically identical (apart from differences arising from contrasting eruption styles). Nonetheless, phenocrysts and glasses exhibit substantial compositional variations and complex textural relations throughout the sequence. Very few phenocrysts appear to have been in equilibrium with the matrix rhyolitic liquid. The petrologic relationships are interpreted to result from partial melting of a pre-existing crustal igneous rock, probably of dioritic to granodioritic composition, and subsequent eruption of the resulting liquid and "restite" crystals. Kinetic arguments suggest a time-scale for magma production and eruption of the order of thousands of years.

42296 **(NAGRA-NTB—84-11) Micro-earthquake investigation of Northern Switzerland. Part I: Technical documentation, network of measuring stations.** Mayer-Rosa, D.; Dietiker, M.; Deichmann, N.; Renggli, K.; Braendli, J.; Studer, J.; Rutishauser, G. (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Mar 1984. 64p. (In German). Nagra, CH-5401 Baden, Switzerland.

The investigation of micro-earthquakes in a low-seismicity region is a well known method to provide insight into the dynamics of the existing neotectonic regime. Such a study supplies the largest possible number of earthquake recordings within a reasonably short time span. The region of Northern Switzerland is such a low-seismicity area for which at least preliminary scientific information on location and source mechanism of earthquakes is required by the end of 1984. For this reason, during the second half of 1983, a modern micro-seismic station network with 9 new stations was installed in Northern Switzerland with the aim of lowering the magnitude threshold for recording local earthquakes in this region to less than 1.0 (Richter-Scale). The present report is devoted mainly to the technical specifications of the new network and includes two recorded events merely as examples illustrating the recording and processing procedure. A comprehensive presentation of the recorded data will be given in a following report.

42297 **(NAGRA-NTB—84-12) Micro-earthquake investigation of Northern Switzerland. Part 2. Seismicity, January 1983-September 1984.** Deichmann, N.; Renggli, K. (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Oct 1984. 65p. (In German). Nagra, CH-5401 Baden, Switzerland.

In the context of neotectonic studies undertaken by NAGRA, the Swiss Seismological Survey (SSS) was contracted to monitor the ongoing seismic activity in the northern part of Switzerland and in the surrounding areas. In order to be able to record even the weaker events, a new seismometer array, complementary to the standard one of the SSS, was installed in Northern Switzerland. With the aid of this new network, the recording sensitivity and accuracy of hypocenter location could be improved significantly. The time period covered by this report extends from January 1983 to September 1984. During this time, the most important events include a magnitude 4 earthquake, which was located near Zuerich and was felt rather strongly over large parts of Northern

Switzerland, as well as three earthquakes of magnitude 3. In addition, an extraordinary series of 20 earthquakes with magnitudes between 1.8 and 3.0, originating from a depth of 1 to 2 km, was recorded over a period of only ten days, in September 1983, near Diessenhofen (TG). Nevertheless, compared to previous periods of observation, the overall seismicity in the region of Northern Switzerland does not exhibit any significant differences: seismic activity is concentrated mainly along the southeastern border of the Rhinegraben and beneath the adjoining parts of the Swiss Jura, as well as in the Kanton of Zuerich. Due to the insufficiently long period of observation, it is however, not yet possible to draw any farther reaching conclusions regarding the lack of seismicity in the other parts of the region.

42298 **(NAGRA-NTB—84-14) Geophysical investigation program for Northern Switzerland: aeromagnetic and ground-magnetic measurements 81.** Klingele, E.; Schwendener, H.; Heim, Ch. (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Oct 1984. 75p. (In German). Nagra, CH-5401 Baden, Switzerland.

In the framework of the geophysical investigations of NAGRA in Northern Switzerland the Swiss Geophysical Commission has surveyed a total of 6250 km of aeromagnetic lines at two different flight levels. Furthermore, a ground-magnetic pilot programme comprising 1480 stations was carried out in the Hornussen area. The aeromagnetic data are presented on a series of maps. They show no anomalies that allow a determination of the depth to the crystalline basement and of the Permo-carboniferous trough embedded therein. A modelling study has shown that this phenomena can be explained by the small susceptibility contrasts between sediments and crystalline rocks as determined on core samples. The ground-magnetic investigations do not allow an interpretation as all mapped anomalies had to be attributed to man-made sources.

42299 **(NAGRA-NTB—84-15) Geophysical investigation program for Northern Switzerland: reflex seismics 82.** Sprecher, C.; Mueller, W.H. (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Jun 1986. 181p. (In German). Nagra, CH-5401 Baden, Switzerland.

As part of Nagra's regional geophysical investigations in Northern Switzerland, a first seismic reflection survey was carried out in 1981. Data on 11 lines with a total length of 182 km were recorded. The primary objective of the survey was the reconnaissance of the Mesozoic sediments of the eastern Jura and the depth of the crystalline basement surface. Of particular importance were the local structural conditions in the vicinity of the proposed Nagra drill-sites. All seismic sections were processed and available for interpretation before the drilling program was started. The information content of the data turned out to be significantly different in the two main, superimposed geological units. In the range of the Mesozoic overburden the seismic image is in general distinctive with high resolution and good continuity. Below the Mesozoic, however, the reflectivity was found to be poor and the interpretation of the data was much more difficult. Generally there are no direct reflections from the crystalline basement surface. Laminated reflections below the Mesozoic, which seemed to indicate the presence of Paleozoic sediments, occur only in certain parts of the survey area and are rarely conspicuous. It was already known on the basis of earlier geophysical data (Refraction seismic survey 81, Gravity survey 81/82) that a deep Paleozoic trough may exist just north of the Folded Jura. Locally the reflection data provided further strong and conclusive evidence (e.g. WEIACH region) but the true dimensions of what is now known as the Permocarboniferous Trough of Northern Switzerland were only revealed after the well RINIKEN had been drilled. Based on the drilling result and the sporadic seismic indications, it was finally possible to map the approximate shape of the trough.

42300 **(NAGRA-NTB—84-17) Determination of recent movements of the earth crust by geodetic methods.** Gubler, E.; Schneider, D.; Kellerhals, P. (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Jun 1984. 63p. (In German). Nagra, CH-5401 Baden, Switzerland.

In the course of neotectonic investigations by NAGRA (National Cooperative for the Storage of Radioactive Waste), the Federal Office of Topography conducted an intensive analysis of the levellings in the area of northern Switzerland. All 280 bench marks used in the first (1906-30) as well as in the second national levelling net (1949-82) were visited and geologically evaluated. Mean vertical movements for the last 40 - 70 years could be determined from the 190 most reliable bench marks. Relative to a group of bench marks anchored in gneiss in Laufenburg, a subsidence in the order of 0.2 - 0.3 mm/year can be shown for the area between Schwaderloch and Rekingen and an uplift of 0.1 - 0.3 mm/year for the area between Wildegg and Baden. These movements are most probably significant. The probability that there are relative height changes between these two zones is even greater. Only isolated movements can be found in the other areas.

42301 **(NUREG/CR—4851) Seismicity 1886-89 in the southeastern United States: The aftershock sequence of the Charleston, South Carolina earthquake.** Armbruster, J.G.; Seeber, L. (Columbia Univ., Palisades, NY (USA). Lamont-Doherty Geological Observatory; Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering). May 1987. 43p. NTIS, PC E03/MF A01 - GPO. File Number TI87900915.

Includes 3 sheets of 24x reduction microfiche.

A search of contemporary newspapers in the Carolinas, Georgia and eastern Tennessee during the 1886-1889 (inclusive) aftershock sequence of the Charleston earthquake of 1886 has provided more than 3000 intensity reports for 522 earthquakes as compared to 144 previously known earthquakes for the same period. Of these 144 events, 138 were felt in Charleston/Summerville and had been assigned epicenters in that area. The new data provide 112 well-constrained macroseismic epicenters. The 1886-1889 seismicity is characterized by a linear relation between log frequency and magnitude with a slope b $\sim$ 1, a temporal decay of earthquake frequency proportional to time, and a low level of seismicity prior to the main shock. These are frequently observed characteristics of aftershock sequences. By 1889, the level of seismicity had decreased more than 2 orders of magnitude, reaching approximately the current level in the same area. The 1886-1889 epicenters delineate a large aftershock zone that extends northwest about 250 km from the coast into the Piedmont and at least 100 km along the Fall Line. The aftershock zone occupies the same area as a zone of recent seismicity with unique characteristics. The portion of this zone in the Piedmont is the only area of the southeastern United States where reservoir-induced seismicity is unambiguously recognized. Seismicity elsewhere in the Southeast, such as in the Virginia seismic zone, is deeper and apparently unrelated to reservoir loading.

42302 **(NUREG/CR—4974) Intraplate seismicity in the eastern United States.** Bollinger, G.A.; Ehlers, E.G. Jr.; Moses, M.J. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering). Jul 1987. 25p. NTIS, PC A02/MF A01 - GPO. File Number TI87900908.

Causes for intraplate earthquakes in the eastern United States are indeed complex. Spatially, the seismicity occurs in distinct zones superposed on a less active regional background level. Epicentral patterns tend to be linear within the Valley and Ridge Province (Giles County and eastern Tennessee), diffuse in the Piedmont (central Virginia), and cluster in the Coastal Plain Province (Charleston, South Carolina area). Historically, moderate to large earthquakes have occurred within the seismic zones as defined by microseismicity. Recent paleoseismicity studies suggest that these larger earthquakes can reasonably be expected to occur into the future. Earthquake focal depths in the eastern US tend to occur within the upper crust with little relation to the surficial features. Most hypotheses on the causes for seismicity invoke the idea of preexisting zones of weakness favorably oriented with respect to the ambient stress field. Because most eastern US seismic zones are buried in the subsurface, geophysical methods are used to infer the presence of possible causal geologic structures at depth. Gravity data are useful in locating density (lithologic) changes within the crust and seismic activity tends to concentrate within gravity saddles formed at the intersection of northeast and northwest trending

gravity anomalies. Seismically important plutons and Triassic basins which are associated with seismic activity have been located by their magnetic signatures. The eastern US is interpreted to be composed of a mosaic of allochthonous suspect terranes. This hypothesis suggests that block boundaries are zones of crustal weakness. Seismicity tends to concentrate along the Avalon-Piedmont boundary in the southeastern US. Many earthquakes in the eastern US occur in paleorift zones and/or at the intersection of multiple tectonic features.

42303 **(NUREG/CR—4975) A review of the resolving power of reflection seismology methods to detect subsurface faults and/or changes in layer thickness.** Costain, J.K.; Coruh, C. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering). Jul 1987. 35p. NTIS, PC A03 - GPO. File Number DE87900907.

Aspects of the resolving power of seismic reflection data in detecting subsurface faults are reviewed. Resolution by reflection seismology of displacements across subsurface faults is coupled with the detection and resolution of thin beds. Limits of detail that can be derived from seismic data are greatly affected by data acquisition and processing parameters. Temporal and spatial bandwidths as keys for seismic resolution are determined by source, recording system, absorption, patterns, temporal frequency range, group interval, temporal and spatial noise. Optimum time wavelets are important for maximum resolution in time which also affects resolution in the spatial domain. Response of vibrators and the use of force control units are reviewed along with the effects of source and receiver arrays used during data acquisition. Phase changes due to decoupling and phase compensation are included in the discussion. The importance of balancing the effects of intrinsic damping before stack is discussed, as are the effects of data windowing in time and space. Parameters affecting resolution along time and spatial axes are given to show that the Fresnel zone introduces an important limitation on the detail that can be derived from seismic data.

42304 **(PB—87-190849/XAB) Seismic analysis of pipelines with yielding supports. Technical report.** Ibell, C.; Mercer, C.D.; Martin, J.B. (Cape Town Univ. (South Africa). Dept. of Civil Engineering). Dec 1984. 22p. (TR—55). NTIS, PC PC E04/MF E04.

Pipelines in structures such as a nuclear reactor can be analysed separately when the structure is subjected to seismic type loading. The pipeline is modelled with various types of supports, such as a rigid support or an elastic support. The pipeline is analysed and designed so that stresses in the pipeline and at the supports are acceptable. If the pipeline is subjected to a larger-intensity earthquake than that designed for, the stresses at some supports may exceed the yield stresses, causing the support to yield. The yielding of a support can influence the response at the other supports in the pipeline, and in some cases cause failure of the supports to occur. The paper examines ways of predicting the changes in the maximum response at supports when one support in a pipeline yields.

42305 **(SAND—87-1384) Seismic data compression using linear predictive coding.** Stearns, S.D. (Sandia National Labs., Albuquerque, NM (USA)). Jul 1987. Contract AC04-76DP00789. 51p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87013412.

This report is on the application of linear predictive coding, which has been applied successfully to many types of sample sequences taken from natural signals, to the compression of seismic data. Designs for encoding and decoding data from a single seismic channel and also from multiple seismic channels in a seismic array are studied. Single-channel prediction, as opposed to multiple-channel prediction using a reference signal, turns out to offer the largest reduction in overall data rate for a given accuracy of reconstruction. When applied to data taken during several NRSA events at 40 samples/s, single-channel predictive encoding consistently produced savings (relative to ordinary quantization) of approximately 200 bits/s over a wide range of data rates corresponding with varying degrees of accuracy of the encoded signals. With background data preceding these events the savings were less, but still approached 100 bits/s.

42306 **(SAND—87-1584) Volcanic eruptions and research drilling in the Inyo Domes Chain.** McConnell, V.S.; Eichelberger, J.C. (Sandia National Labs., Albuquerque, NM (USA)). Jul 1987. Contract AC04-76DP00789. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013411.

This booklet is a non-technical guide for visitors to the Inyo Craters and Sandia drilling operation, covering kinds of volcanic eruptions, research drilling into volcanoes, and environmental aspects.

42307 **(SAND—87-1652C) Seafloor earthquake measurement system.** Sleefe, G; Engler, B. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 10p. (CONF-870728—6). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013065.

From Unconventional gas recovery and utilization; Morgantown, WV, USA (28 Jul 1987).

The Seafloor Earthquake Measurement Project has had two principal objectives. The first being to design, fabricate and yield systems to measure the response of seafloor sediment to earthquakes. The second objective is to utilize data obtained from the measurement system to validate and if necessary, modify existing models for seafloor earthquake response. Two significant earthquakes were measured by the Seafloor Earthquake Measurement System (SEMS) during July 1986. Preliminary analysis of the sediment response measurements obtained by SEMS indicates that, (1) the seabed responds comparably to the ground in terms of its vibrational frequency, (2) the sediments vibrate primarily in the horizontal directions, and (3) the data confirms the presence of distance-dependent wave attenuation. Further analysis of this data set and future off-shore seismic recordings should give invaluable insight into the design of offshore structures. 3 refs., 6 figs., 1 tab.

5803 Mineralogy, Petrology, And Rock Mechanics

REFER ALSO TO CITATION(S) 40542

42308 **(NAGRA-NTB—84-30) Crystalline of the Southern Black Forest.** Huber-Aleffi, M.; Huber-Aleffi, A. (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Dec 1984. 234p. (In German). Nagra, CH-5401 Baden, Switzerland.

The crystalline basement of the northern part of Central Switzerland continues into the massif of the Black Forest, where due to strong uplift and erosion this basement can be studied in surface outcrops. In the project Southern Black Forest possible geological connections between the two regions are examined and similar lithological and structural situations are established. In the first part of this report, the complex geological evolution of the basement in the Black Forest is reconstructed on the base of publications of various authors. The great lithological variation of the crystalline rocks is described in some detail; a list of all granites in the studied area is given in the appendix. The main elements of the tectonic and structural history are reviewed in the second part. The basement of Southern Black Forest is subdivided into several large blocks which are separated by faults zones. Discontinuities in the basement are described in the third part of this report. The methods for investigating structures of brittle deformation and the corresponding nomenclature are summarized. Preliminary data of a detailed analysis of joints in more than 40 localities suggest the existence of well defined fracture systems.

5804 Geochemistry

REFER ALSO TO CITATION(S) 40642, 40646

42309 **(CONF-8609134—Absts.) Collected abstracts for the workshop on geochemical modeling.** (Lawrence Livermore National Lab., CA (USA)). 1986. Contract W-7405-ENG-48. 43p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87012570.

From Geochemical modelling workshop; Fallen Leaf Lake, CA, USA (14 Sep 1986).

Separate abstracts have been prepared for twenty-two of the twenty-eight presentations. (ACR)

64 PHYSICS I

REFER ALSO TO CITATION(S) 41627

6401 Astrophysics And Cosmology

REFER ALSO TO CITATION(S) 42434, 42488, 42565, 42662, 42663, 42666

42310 **(AD-A—180302/2/XAB) Speculations about the origin of H_3O^+ seen in cometary mass spectra.** Murad, E.; Bochsler, P. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). 26 Mar 1987. 3p. (AFGL-TR—87-0146). NTIS, PC A02/MF A01.

Pub. in Nature, Vol. 326, 366-367(26 Mar 1987).

Recent mass-spectrometer measurements of the composition of the coma of Giacombini Zinner and Haley comets have indicated the presence of large amounts of $H_3O(+)$. SOme of these ions arise from the photoionization of the water dimer, which is formed by direct vaporization of ice from solid surfaces at the cometary necleus or from ice particles ejected in cometary jets.

42311 **(ANL-HEP-CP—87-37) A measurement of the hadronic component of air showers in a fine grained calorimeter.** Goodman, M.C.; Ellsworth, G.B.; Bofill, J.; Bogert, D.; Freudenreich, H.; Goodman, J.A.; Buzza, W.; Eldridge, T.; Abolins, M.; Gupta, S.C. . (Argonne National Lab., IL (USA); George Mason Univ., Fairfax, VA (USA); Fermi National Accelerator Lab., Batavia, IL (USA); Maryland Univ., College Park (USA); Massachusetts Inst. of Tech., Cambridge (USA); Michigan State Univ., East Lansing (USA)). 1987. Contract W-31109-ENG-38. 4p. (CONF-870855—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011382.

From 20. international cosmic ray conference; Moscow, USSR (2 Aug 1987).

The hadronic component of extensive air showers is studied using the E594 fine grained calorimeter and a air shower array trigger. Hadron angle and energy distributions are shown. Events with more than one separated hadron with substantial energy are studied carefully. The correlation of hadronic and muonic components is shown. 2 refs., 3 figs.

42312 **(CBPF-NF—002/86) Homogeneous cosmos of Weyssenhoff fluid in Einstein-Cartan Space.** Oliveira, J.D. de. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1986. 19p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702662.

The role played by the spin of matter in homogeneous Goedel-type universes is investigated. It is shown that the region of parametrization $m^2 <= 4\Omega^2$ for solutions of Einstein's equations with fluid and fields (as obtained by Reboucas and Tiommo) can be extended to $m^2 > 4\Omega^2$, in Einstein-Cartan space. Properties of the solutions are examined.

42313 **(CEA-CONF—8700) Void probability function as a statistical indicator.** Lachieze-Rey, M.; Maurogordato, S. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Inst. de Recherche Fondamentale (IRF)). Aug 1986. 5p. (CONF-8608177—1). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752253.

From IAU symposium on observational cosmology; Beijing, China (25 Aug 1986).

Recent results concerning the galaxy distribution at scales lower than 100 h/sup -1/ Mpc show a number of characteristics which cannot be described by conventional statistical models. Correlation functions, for instance, can in no way give account of the presence of voids of the cellular (or spongy) appearance of the local galaxy distribution (M. Geller, this conference). There is clearly a need for new kinds of statistical models and statistical indicators. Among those we wish to emphasize the advantages of the void probability function (VPF), and its particular convenience for studying the galaxy distribution.

42314 **(EFI—805(32)-85) Ultrahigh energy electron spectrum formation in galaxy.** Agaronyan, F.A.; Ambartsumyan, A.S. (Erevanskij Fizicheskij Inst. (USSR)). 1985. 14p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702674.

The formation of ultrahigh energy electron spectra is the disk of the Galaxy and in the halo is considered. Different behaviour of the electron spectra in the models of disk and halo in the energy range $E \geqq 10^5$ GeV due to relativistic corrections in the energy loss of the electrons at inverse Compton scattering is revealed. A comparison with experimental data is discussed.

42315 **(IC—86/198) Cosmological Kaluza-Klein monopoles.** Miao Li. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1986. 11p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702571.

A solution of a pair of monopoles in 5d Kaluza-Klein theory without matter fields is given. The scale of the internal space is the same as that of the outer space. Its Euclidean version is useful for calculating the wave function of the universe with monopoles. 9 references.

42316 **(INIS-mf—10923) Primordial high-frequency perturbations in cosmology.** Slagter, R.J. (Amsterdam Univ. (Netherlands)). 17 Dec 1986. 135p. NTIS (US Sales Only), PC A07/MF A01. File Number DE87702790.

The purpose of this thesis is to investigate, with the help of the multiple-scale method, approximate solutions of the Einstein equations which are approximately periodic and can be interpreted as containing high-frequency waves. These primordial high-frequency perturbations will have a significant influence on the background metric (back-reaction) and formation of trapped surfaces. Detection and Fourier analysis of primordial gravitational waves could in principle be used to infer the spectrum of inhomogeneities in the very early epoch of the universe. The high-frequency gravitational waves of all modes are investigated on an anisotropic Bianchi IX background. Their frequencies are related to the eigenvalues of the Hamiltonian of the asymmetric rotor. In the context of the exact solitary wave solutions found on the inhomogeneous Einstein-Rosen metric, a numerical solution is presented of the complete set of equations obtained from the non-linear approximation. 144 references, 48 figures.

42317 **(INIS-mf—10932) Polarization of radio galaxies. Its structure at low frequencies.** Jaegers, W.J. (Rijksuniversiteit Leiden (Netherlands)). 2 Dec 1986. 277p. (In Chinese). NTIS (US Sales Only), PC A13/MF A01. File Number DE87702798.

In this thesis radio observations at 0.6 GHz together with matched (convolved) observations at 1.4 GHz of 30 radiosources are described and interpreted. Sources of great interest which are individually discussed are the complex nearby source 3C66B, the source 4C73.48, the narrow edge-darkened double source 3C130 (together with two newly observed narrow-edge-darkened doubles), the galaxies 3C129 and 3C390.3 and the giant quasar 4C34.47.

42318 (JINR—D-10-11-84-818, pp 281-284) **Mathematical methods in the problem of reconstruction of hadron interaction characteristics and primary cosmic ray spectra at superhigh energies.** Astaf'ev, V.A. (Moskovskij Gosudarstvennyj Univ., USSR. Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki). 1985. (In Russian). NTIS (US Sales Only), PC A16/MF A01. File Number DE87780164. (CONF-8309402—).

From 5. international meeting on problems of mathematical simulation, programming, and mathematical methods for solving the physical problems; Dubna, USSR (20 Sep 1983).

The paper reviews the mathematical methods used for analyzing the experimental data obtained in investigations of cosmic rays of superhigh energies (10/sup 14/-10/sup 19/ eV). The analysis is carried out on the basis of the direct problem solution, i.e. calculation of the characteristics of nuclear-electromagnetic cascade showers developed in the atmosphere with regard to the specific features of experimental devices. The analytical and numerical metods for solving equations describing shower development, as

well as simulation of cascade processes by the Monte Carlo method are applied herein. 12 refs.

42319 (N—87-21785) **Rapid fluctuations in solar flares.** Dennis, B. R.; Orwig, L. E.; Kiplinger, A. L. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). 1986. 491p. (NASA-CP—2449; NAS—1.55:2449; CONF-8509317—). NTIS, PC A21/MF A01.

From SMM topical workshop on rapid fluctuations in solar flares; Lanham, MD, USA (30 Sep 1985).

Topics addressed include: x rays; radio and microwaves; thermal response; plasma physics; and future plans.

42320 (N—87-21785, pp vp) **Electron-cyclotron maser emission during flares: emission in various modes and temporal variations.** Winglee, R.M.; Dulk, G.A. (Colorado Univ., Boulder). 1986. NTIS, PC A21/MF A01. (NASA-CP—2449; NAS—1.55:2449; CONF-8509317—).

From SMM topical workshop on rapid fluctuations in solar flares; Lanham, MD, USA (30 Sep 1985).

Absorption of radiation at the electron-cyclotron frequency, OMEGA sub e, generated by the electron-cyclotron maser instability was proposed as a possible mechanism for transporting energy and heating of the corona during flares. Radiation from the same instability but at harmonics of OMEGA sub e is believed to be the source of solar microwave spike bursts. The actual mode and frequency of the dominant emission from the maser instability is shown to be dependent on: (1) the plasma temperature, (2) the form of the energetic electron distribution, and (3) on the ratio of the plasma frequency omega sub p to OMEGA sub e. As a result, the emission along a flux tube can vary, with emission at harmonics being favored in regions where omega sub p/OMEGA sub e approx. equal to or greater than 1. Changes in the plasma density and temperature in the source region associated with the flare can also cause the characteristics of the emission to change in time.

42321 (N—87-21785, pp vp) **Impulsively generated fast coronal pulsations.** Edwin, P.M.; Roberts, B. 1986. NTIS, PC A21/MF A01. (NASA-CP—2449; NAS—1.55:2449; CONF-8509317—).

From SMM topical workshop on rapid fluctuations in solar flares; Lanham, MD, USA (30 Sep 1985).

Rapid oscillations in the corona are discussed from a theoretical standpoint, developing some previous work on ducted, fast magnetoacoustic waves in an inhomogeneous medium. In the theory, impulsively (e.g., flare) generated mhd (magnetohydrodynamic) waves are ducted by regions of low Alfven speed (high density) such as coronal loops. Wave propagation in such ducts is strongly dispersive and closely akin to the behavior of Love waves in seismology, Pekeris waves in oceanography and guided waves in fiber optics. Such flare-generated magnetoacoustic waves possess distinctive temporal signatures consisting of periodic, quasi-periodic and decay phases. The quasi-periodic phase possesses the strongest amplitudes and the shortest time scales. Time scales are typically of the order of a second for inhomogeneities (coronal loop width) of 1000 km and Alfven speeds of 1000/kms, and pulse duration times are of tens of seconds. Quasi-periodic signatures have been observed in radio wavelengths for over a decade and more recently by SMM. It is hoped that the theoretical ideas outlined may be successfully related to these observations and thus aid the interpretation of oscillatory signatures recorded by SMM. Such signatures may also provide a diagnostic of coronal conditions. New aspects of the ducted mhd waves, for example their behavior in smoothly varying as opposed to tube-like inhomogeneities, are currently under investigation. The theory is not restricted to loops but applied equally to open field regions.

42322 (N—87-21785, pp vp) **Shock acceleration of electrons and ions in solar flares.** Ellison, D.C.; Ramaty, R. (Maryland Univ., College Park). 1986. NTIS, PC A21/MF A01. (NASA-CP—2449; NAS—1.55:2449; CONF-8509317—).

From SMM topical workshop on rapid fluctuations in solar flares; Lanham, MD, USA (30 Sep 1985).

The simultaneous first-order Fermi shock acceleration of electrons, protons, and alpha particles are compared to observations of solar energetic particle events. For each event, a unique shock compression ratio in the range approx. 1.6 to 3 produces spectra in good agreement with observation. The range in compression ratios predicts that the more than 5 orders of magnitude spread in electron to proton intensity ratios observed at MeV energies is compressed to about 3 orders of magnitude at an assumed injection energy of 100 keV. The remaining spread can be accounted for with a modest range of injection conditions. The model predicts that the acceleration time to a given energy will be approximately equal for electrons and protons and, for reasonable solar parameters, can be on the order of 1 second to approx. 100 MeV.

42323 (N—87-21785, pp vp) **Generation of rapid solar flare hard X-ray and microwave fluctuations in current sheets.** Holman, G.D. 1986. NTIS, PC A21/MF A01. (NASA-CP—2449; NAS—1.55:2449; CONF-8509317—).

From SMM topical workshop on rapid fluctuations in solar flares; Lanham, MD, USA (30 Sep 1985).

The generation of rapid fluctuations, or spikes, in hard x-ray and microwave bursts via the disruption of electron heating and acceleration in current sheets is studied. It is found that 20 msec hard x-ray fluctuations can be thermally generated in a current sheet if the resistivity in the sheet is highly anomalous, the plasma density in the emitting region is relatively high, and the volume of the emitting region is greater than that of the current sheet. A specific mechanism for producing the fluctuations, involving heating in the presence of ion acoustic turbulence and a constant driving electric field, and interruption of the heating by a strong two-stream instability, is discussed. Variations upon this mechanism are also discussed. This mechanism also modulates electron acceleration, as required for the microwave spike emission. If the hard x-ray emission at energies less than approx. 1000 keV is nonthermal bremsstrahlung, the coherent modulation of electron acceleration in a large number of current sheets is required.

42324 (N—87-21785, pp vp) **Quasi-linear relaxation of thick-target electron beams in solar flares.** Mcclements, K.G.; Brown, J.C.; Emslie, A.G. (Alabama Univ., Huntsville). 1986. NTIS, PC A21/MF A01. (NASA-CP—2449; NAS—1.55:2449; CONF-8509317—).

From SMM topical workshop on rapid fluctuations in solar flares; Lanham, MD, USA (30 Sep 1985).

The effects of quasi-linear interactions on thick-target electron beams in the solar corona are investigated. Coulomb collisions produce regions of positive gradient in electron distributions which are initially monotonic decreasing functions of energy. In the resulting two-stream instability, energy and momentum are transferred from electrons to Langmuir waves and the region of positive slope in the electron distribution is replaced by a plateau. In the corona, the timescale for this quasi-linear relaxation is very short compared to the collision time. It is therefore possible to model the effects of quasi-linear relaxation by replacing any region of positive slop in the distribution by a plateau at each time step, in such a way as to conserve particle number. The x-ray bremsstrahlung and collisional heating rate produced by a relaxed beam are evaluated. Although the analysis is strictly steady state, it is relevant to the theoretical interpretation of hard x-ray bursts with durations of the order of a few seconds (i.e., the majority of such bursts).

42325 (N—87-21785, pp vp) **Propagation of solar flare particles in a coronal loop.** Ryan, J.M. 1986. NTIS, PC A21/MF A01. (NASA-CP—2449; NAS—1.55:2449; CONF-8509317—).

From SMM topical workshop on rapid fluctuations in solar flares; Lanham, MD, USA (30 Sep 1985).

A time-dependent diffusion equation with velocity-dependent diffusion and energy-loss coefficients was solved for the case where energetic solar particles are injected into a coronal loop and then diffuse out the ends of the loop into the lower corona/chromosphere. The solution yields for the case of relativistic electrons, precipitation rates and populations which are necessary for calculating thick and thin target x-ray emission. It follows that the thick target emission is necessarily delayed with respect to the particle acceleration on injection by more than the mere travel time of the particle over the loop length. In addition the time-dependent electron population at the top of the loop is calculated. This is useful in estimat-

ing the resulting micron-wave emission. The results show relative timing differences in the different emission processes which are functions of particle species, energy and the point of injection of the particles into the loop. Equivalent quantities are calculated for non-relativistic protons.

42326 (N—87-21785, pp vp) **Signatures of current loop coalescence in solar flares.** Sakai, J.; Nakajima, H.; Zaidman, E.; Tajima, T.; Kosugi, T.; Brunel, F. (Tokyo Astronomical Observatory, Japan; Texas Univ., Austin; National Research Council of Canada, Ottawa, Ontario). 1986. NTIS, PC A21/MF A01. (NASA-CP—2449; NAS—1.55:2449; CONF-8509317—).

From SMM topical workshop on rapid fluctuations in solar flares; Lanham, MD, USA (30 Sep 1985).

The nonlinear coalescence instability of current carrying solar loops can explain many of the characteristics of the solar flares such as their impulsive nature, heating and high energy particle acceleration, amplitude oscillations of electromagnetic emission as well as the characteristics of 2-D microwave images obtained during a solar flare. The physical characteristics of the explosive coalescence of currents are presented in detail through computer simulation and theory. Canonical characteristics of the explosive coalescence are: (1) a large amount of impulsive increase of kinetic energies of electrons and ions; (2) simultaneous heating and acceleration of electrons and ions in high and low energy spectra; (3) ensuing quasi-periodic amplitude oscillations in fields and particle quantities; and (4) the double peak (or triple peak) structure in these profiles, participate in the coalescence process, yielding varieties of phenomena.

42327 (N—87-21785, pp vp) **Thermal waves or beam heating in the 1980, November 5 flare.** Smith, D.F. 1986. NTIS, PC A21/MF A01. (NASA-CP—2449; NAS—1.55:2449; CONF-8509317—).

From SMM topical workshop on rapid fluctuations in solar flares; Lanham, MD, USA (30 Sep 1985).

Observations of the temporal evolution of loop BC in soft x rays in the November 5, 1980 flare are reviewed. Calculations are performed to model this evolution. The most consistent interpretation involving a minimum account of energy is the following. Thermal heating near B gives rise to a conduction front which moves out along the loop uninhibited for about 27 s. Beam heating near C gives rise to a second conduction front which moves in the opposite direction and prevents any energy reaching C by thermal conduction from B. Thus both thermal waves and beam heating are required to explain the observed evolution.

42328 (N—87-21785, pp vp) **Double layer model for solar X-ray and microwave pulsations.** Tapping, K.F. 1986. NTIS, PC A21/MF A01. (NASA-CP—2449; NAS—1.55:2449; CONF-8509317—).

From SMM topical workshop on rapid fluctuations in solar flares; Lanham, MD, USA (30 Sep 1985).

The wide range of wavelengths over which quasi-periodic pulsations have been observed suggests that the mechanism causing them acts upon the supply of high energy electrons driving the emission processes. A model is described which is based upon the radial shrinkage of a magnetic flux tube. The concentration of the current, along with the reduction in the number of available charge carriers, can rise to a condition where the current demand exceeds the capacity of the thermal electrons. Driven by the large inductance of the external current circuit, an instability takes place in the tube throat, resulting in the formation of a potential double layer, which then accelerates electrons and ions to MeV energies. The double layer can be unstable, collapsing and reforming repeatedly. The resulting pulsed particle beams give rise to pulsating emission which are observed at radio and x-ray wavelengths.

42329 (N—87-21785, pp vp) **Theoretical studies on rapid fluctuations in solar flares.** Vlahos, L. 1986. NTIS, PC A21/MF A01. (NASA-CP—2449; NAS—1.55:2449; CONF-8509317—).

From SMM topical workshop on rapid fluctuations in solar flares; Lanham, MD, USA (30 Sep 1985).

Rapid fluctuations in the emission of solar bursts may have many different origins, e.g., the acceleration process can have a pulsating structure, the propagation of energetic electrons and ions can be interrupted from plasma instabilities and finally the electromagnetic radiation produced by the interaction of electrostatic and electromagnetic waves may have a pulsating behavior in time. In two separate studies the conditions for rapid fluctuations in solar flare driven emission were analyzed.

42330 (N—87-21785, pp vp) **HESP (High Energy Solar Physics) project.** Kai, K. 1986. NTIS, PC A21/MF A01. (NASA-CP—2449; NAS—1.55:2449; CONF-8509317—).

From SMM topical workshop on rapid fluctuations in solar flares; Lanham, MD, USA (30 Sep 1985).

A project for space observations of solar flares for the coming solar maximum phase is briefly described. The main objective is to make a comprehensive study of high energy phenomena of flares through simultaneous imagings in both hard and soft x rays. The project will be performed with collaboration from US scientists. The HESP (High Energy Solar Physics) WG of ISAS (Institute of Space and Astronautical Sciences) has extensively discussed future aspects of space observations of high energy phenomena of solar flares based on successful results of the Hinotori mission, and proposed a comprehensive research program for the next solar maximum, called the HESP (SOLAR-A) project. The objective of the HESP project is to make a comprehensive study of both high energy phenomena of flares and quiet structures including preflare states, which have been left uncovered by SMM and Hinotori. For such a study simultaneous imagings with better resolutions in space and time in a wide range of energy will be extremely important.

42331 (N—87-23563) **Preliminary summary of the observations of the 16 February 1984 solar flare (STIP interval XV, 12-21 February 1984).** Kane, S.R.; Urbarz, H.W. (California Univ., Berkeley (USA)). 1987. 10p. (NASA-CR—180929; NAS—1.26:180929). NTIS, PC A02/MF A01.

The solar flare on 16 Feb. 1984 (0900 UT) and the associated photon and particle emissions were perhaps the most interesting solar and interplanetary phenomena during STIP Interval XV, 12 to 21 Feb. 1984. The x-ray and microwave radio emissions, as observed from the Earth, were relatively weak and no optical flare was reported. However, the hard x-ray and low energy gamma-ray observations made with the Pioneer Venus Orbiter spacecraft behind the west limb of the Sun indicate that the flare was, in reality, very intense. There is evidence that the flare was located approx 40 deg behind the west limb of the Sun and hence, for instruments located near the Earth, the most intense parts of the x-ray and microwave radio sources were occulted by the photosphere. However, the effect of occultation on the metric type II, type III, and type IV and decimetric (type DCIM) radio sources appeared to be relatively small. Following the flare, a large increase in the counting rates was recorded by several ground level neutron monitors and energetic particle detectors located in interplanetary space. A preliminary analysis of the 16 Feb. 1984 flare observations follows.

42332 (N—87-23564) **X-ray and low energy gamma-ray observations of the 16 February 1984 solar flare.** Kane, S.R.; Klebesadel, R.W.; Fenimore, E.E.; Laros, J.G. (California Univ., Berkeley (USA)). 1987. 4p. (NASA-CR—180928; NAS—1.26:180928). NTIS, PC A02/MF A01.

The February 16, 1984 (0900 UT) solar flare was very energetic and produced a variety of emissions. The x-ray and gamma ray continuum measurement, made aboard the International Cometary Explorer (ICE) and the Pioneer Venus Orbiter (PVO), are briefly described.

42333 (PB—87-182028/XAB) **Development and application of three-dimensional time-dependent magnetohydrodynamic numerical model.** Han, S.M. (Tennessee Technological Univ., Cookeville (USA)). Mar 1987. 116p. NTIS, PC A06/MF A01.

Modifications and implementations to the steady, three-dimensional MHD solar wind model (STDSOL) and to the unsteady, three-dimensional MHD solar wind model (UTDSOL) are completed. These models are appropriate for steady and time-dependent

simulations of interplanetary disturbances between 18 solar radii and 1 AU. Example computations for both steady and transient cases were made to examine the capabilities of these models. In addition to two MHD models, a transient one-dimensional hydrodynamic transonic numeric model (TOH) was completed. The model is capable of simulating solar-wind expansions through the hydrodynamic critical point. Example computations were performed for thermally-conductive solar wind between the solar surface and 1 AU.

42334 **Cosmic texture and the microwave background.** Davis, R.L. (Department of Physics, Tufts University, Medford, Massachusetts 02155). *Physical Review [Section] D: Particles and Fields;* **36**: No. 4, 997-999(15 Aug 1987).

The isotropic cosmic microwave background may come from the antipode of a spatially closed, but $\Omega<1$ textured universe.

42335 **Cosmic strings and cosmic structure.** Albrecht, A.; Brandenberger, R.; Turok, N. (Fermi National Accelerator Lab., Batavia, IL, USA; Cambridge Univ., UK. Dept. of Applied Mathematics and Theoretical Physics; Imperial Coll. of Science and Technology, London, UK. Dept. of Physics). *New Scientist (London);* **114**: No. 1556, 40-44(16 Apr 1987).

The paper concerns the application of the theory of cosmic strings to explain the structure of the Universe. The formation of cosmic strings in the early Universe is outlined, along with the Big Bang theory, Grand Unified theories, and the first three minutes after the Big Bang. A description is given of the shaping of the Universe by cosmic strings, including the evolution of the string. The possibility for direct observation of cosmic strings is discussed. (U.K.).

42336 **Cosmic time gauge in quantum cosmology and chaotic inflation model.** Hosoya, A. (Fermi National Accelerator Lab., P.O. Box 500, Batavia, IL 60510). pp 277-285 of Particles and nuclei. Terazawa, H. Teaneck, NJ; World Scientific Pub. Co. (1986).

The author proposes a cosmic time gauge formalism in quantum cosmology to get an equation for the Schrodinger type. Its application to the chaotic inflation scenario reveals that the uncertainty in the scale factor grows exponentially as the universe inflates.

42337 **The nuclear equation of state, general relativity and supernovae explosions.** Kahana, S. (Physics Dept., Brookhaven National Lab., Upton, NY 11973). pp 535-538 of Proceedings of the fifth course of the international school of intermediate energy nuclear physics. Bergere, R.; Costa, S.; Schaerf, C. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-850634—). Contract AC02-76CH00016.

From International school for intermediate energy nuclear physics; Verona, Italy (20 Jun 1985).

Prompt explosions are obtained in hydrodynamic simulations for the 12 Msub solar and 15 Msub solar type II supernova initial models of Weaver and Woosley, when the nuclear equations of state is sufficiently soft and when general relativity is included.

6402 Atmospheric Physics

REFER ALSO TO CITATION(S) 42190

42338 **(AD-A—180270/1/XAB) Pi2 pulsations and the westward traveling surge in the magnetosphere - ionosphere coupling. Final report, 15 November 1985-30 September 1986.** Kan, J.R. (Alaska Univ., Fairbanks (USA). Geophysical Inst.). Nov 1986. 25p. NTIS, PC A02/MF A01.

The dynamics of the westward travelling surge (WTS) is studied in a magnetosphere-ionosphere coupling model. It is shown that the motion of the WTS is governed by the combined effects of the magnetospheric Alfven time scale and the ionospheric recombination time scale. The surge is found to move at variable speeds: the speed is around 6 km/sec westward and less than 1 km/sec northward near the onset of the surge; thereafter, it oscillates irregularly and decreases toward zero. The polar cap potential difference is found to oscillate irregularly as it increases toward the enhanced convection level. The irregular oscillations found in our results are believed to be a general property of mulit-time-scale problems. Keywords: Westward traveling surge; Alfven waves; Magnetosphere ionosphere coupling; Conductivity profiles.

42339 **(AD-A—180295/8/XAB) Equatorward boundary of auroral ion precipitation.** Gussenhoven, M.S.; Hardy, D.A.; Heinemann, N. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). 1 Apr 1987. 12p. (AFGL-TR—87-0141). NTIS, PC A02/MF A01.

Pub. in J. of Geophysical Research, Vol. 92, No. A4, 3273-3283(1 Apr 1987).

Data from the SSJ/4 detector on the Defense Meteorological Satellite Program (DMSP) F6 satellite are used to study the difference in the location of the equatorward boundaries of auroral ion and electron precipitation, and the variation in the difference with magnetic local time and activity. Large geometric factors of the ion sensors of the SSJ/4 detector make identification of the ion boundary unambiguous in most cases. In this study, approximately 900 boundaries each for electrons and ions were determined from all DMSP F6 auroral passes in January of 1983. The boundaries occur over local times from 0400 to 0700 on the morningside of the oval and from 1700 to 2100 on the eveningside. The ion and electron boundaries both move systematically to lower latitudes with increasing magnetic activity, as measured by Kp. Over the evening sector sampled, the ion boundary is on average 1.4 deg equatorward of the electron boundary, with the difference commonly ranging up to 3 deg. For the morning sector sampled, the ion boundary is on average 2.6 deg poleward of the electron boundary with a significant number of cases with difference above 5.0 deg. The separation between the electron and ion boundaries is not dependent on K/sub p/ but but does increase with MLT from midnight toward noon on both the morningside and the eveningside of the oval. The separation in boundaries can be explained by motion in a large-scale, quasi-static convection electric field if the time for development of the ion boundary is explicitly taken into account and if ion pitch angle diffusion is highly energy dependent.

42340 **(AD-A—180323/8/XAB) Filamentary structures in the magnetotail lobes.** Huang, C.Y.; Frank, L.A.; Peterson, W.K.; Williams, D.J.; Lennartsson, W. (Iowa Univ., Iowa City (USA). Dept. of Physics and Astronomy). 1 Mar 1987. 18p. NTIS, PC A02/MF A01.

Pub. in J. of Geophysical Research, Vol. 92, No. A3, 2349-2363(1 Mar 1987); Original contains color plates: All DTIC/NTIS reproductions will be in black and white. Supersedes AD-A168-011.

Filamentary structures consisting of energetic plasma have been observed in the magnetotail lobes. Using plasma, energetic particle, composition, and magnetic field data from the ISEE 1 and 2 spacecraft, one establishes that these structures may be related to polar-cap auroras. The filaments consist of energetic (several keV) plasma with a quasi-isotropic or field-aligned velocity distribution similar to that in the plasma-sheet boundary layer. Composition analysis reveals that the origin of the plasma is the plasma-sheet or plasma-sheet boundary layer. The gradients in the energetic-particle fluxes show that the structures are approximately aligned in the XZ plane, so that the possibility of simple plasma sheet flapping can be ruled out. Field-aligned currents are associated with the filamentary structures. The current densities when mapped along the magnetic-field lines are comparable with low-altitude measurements over the polar cap. While the occurence of the filaments is not correlated with interplanetary conditions, the convection pattern within the filaments appears to be related to the interplanetary magnetic field direction. When the IMF B/sub z/ is positive, the E x B convection is in the sense of a dusk-to-dawn electric field. Observations of field-aligned currents and plasma convection are consistent with those made by polar-orbiting satellites.

42341 **(AD-A—180362/6/XAB) Calculating ionospheric conductances from the flux and energy of precipitating electrons.** Robinson, R.M.; Vondrak, R.R.; Miller, K.; Dabbs, T.; Hardy, D. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). 1 Mar 1986. 6p. (AFGL-TR—87-0152). NTIS, PC A02/MF A01.

Pub. in J. of Geophysical Research, Vol. 92, No. A3, 2565-2569(1 Mar 1987).

Auroral-zone conductances can be estimated from the energy flux and average energy of precipitating electrons. These estimates are based on the assumption that the conductances produced by the electrons are very similar to those produced by electrons with Maxwellian energy distributions having the same energy flux and average energy. There has been some confusion in the application of this method because, for a Maxwellian, the average energy is twice the characteristic energy or temperature. Revised expressions are presented that relate height-integrated Hall and Pedersen conductance to the flux and average energy of a Maxwellian. The accuracy of this method depends on the minimum and maximum energy within which the distribution is integrated to get the energy flux and average energy. The conductances produced by some of the more-common auroral spectral distributions are similar to those produced by a Maxwellian with the same average energy and energy flux. The application of these results is demonstrated using precipitating-electron measurements made by the Hilat satellite during a pass over Greenland.

42342 **(AD-A—180501/9/XAB) Observations of plasma distributions during the coordinated data analysis workshop substorms of March 31 to April 1, 1979.** Huang, C.Y.; Frank, L.A.; Eastman, T.E. (Iowa Univ., Iowa City (USA). Dept. of Physics and Astronomy). 1 Mar 1987. 10p. (U.OF-IOWA—86-12). NTIS, PC A02/MF A01.

Pub. in J. of Geophysical Research, Vol. 92, No. A3, 2377-2384(1 Mar 1987); Supersedes report dated Feb 86, AD-A168-580. Original contains color plates: All DTIC and NTIS reproductions will be in black and white.

On March 31 and April 1, 1979, a sequence of substorms was recorded on the ground. During the entire active period the ISEE 1 and 2 satellites were located in the magnetotail, between 22 R/sub E/ and 12 R/sub E/ from the earth. Observations of plasma distributions made at varying levels of activity during these substorms provide good examples of typical magnetotail responses. These measurements were obtained with the University of Iowa LEPEDEA on board the ISEE 1 spacecraft. While the entire magnetotail undergoes temporal variations during substorm activity, the most obvious effect seen is spatial motion of preexisting plasma regimes, for example, at substorm onset the central plasma sheet contracts. This can cause a spacecraft to move from the plasma sheet into the boundary layer. As the plasma-sheet boundary layer almost always comprises streaming plasma, the high-speed flows observed there are not necessarily due to the substorm process. The essential nature of the main plasma regions of the magnetotail is relatively unchanged during high activity.

42343 **(INIS-BR—655) Atmospheric X-rays - Stratospheric balloon experiment at subantarctic region.** Jayanthi, U.B.; Correa, R.V.; Blanco, F.G. (Sociedade Brasileira de Geofisica, Rio de Janeiro). 1985. 1p. (CONF-8511295—2-Summ.). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702763.

From 1. regional meeting of geophysics; Sao Jose dos Campos, Brazil (27 Nov 1985).

Published in summary form only.

42344 **(INPE—3604) X-ray fluxes in the atmosphere.** Pinto Junior, O.; Alarcon, W.D.G. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). Aug 1985. 10p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702803.

A short review of X-rays measurements in the atmosphere is presented. In this context, the measurements obtained with NaI (Tl) scintillation detectors on board stratospheric balloons launched from Sao Jose dos Campos - Brazil in 1981, are considered as a first evidence of X-rays related to natural electron precipitation at the South Atlantic Magnetic Anomaly. Finally, a comparison of the related fluxes with those due to other sources, at balloon altitudes and at energies around 50KeV, is also given.

42345 **Electron/electron acoustic instability.** Gary, S.P. (Earth and Space Sciences Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physics of Fluids;* **30**: No. 9, 2745-2749(Sep 1987).

The electron acoustic wave becomes a normal mode of an unmagnetized collisionless plasma in the presence of two electron components with similar densities, but strongly disparate temperatures. The characteristic frequency of this mode is the plasma frequency of the cooler electron component. If these two electron components have a relative drift speed several times the thermal speed of the cooler component, the electron/electron acoustic instability may arise. This paper describes the parametric dependences of the threshold drift speed and maximum growth rate of this instability, and compares these with the same properties of the electron/ion acoustic instability. Under the condition of zero current, the electron/ion acoustic instability typically has the lower threshold drift speed, so that observation of the electron/electron acoustic instability is a strong indication of the presence of an electrical current in the plasma.

42346 **Simulation of the electron acoustic instability for a finite-size electron beam system.** Lin, C.S.; Winske, D. (Department of Space Sciences, Southwest Research Institute, San Antonio, Texas). *Journal of Geophysical Research;* **92**: No. A7, 7569-7580(1 Jul 1987).

Satellite observations at midlatitudes (≅20,000 km) near the earth's dayside polar cusp boundary layer indicate that the upward electron beams have a narrow latitudinal width up to 0.1°. In the cusp boundary layer where the electron population consists of a finite-size electron beam in a background of uniform cold and hot electrons, the electron acoustic mode is unstable inside the electron beam but damped outside the electron beam. Simulations of the electron acoustic instability for a finite-size beam system are carried out with a particle-in-cell code to investigate the heating phenomena associated with the instability and the width of the heating region. The simulations show that the finite-size electron beam radiates electrostatic electron acoustic waves. The decay length of the electron acoustic waves outside the beam in the simulation agrees with the spatial decay length derived from the linear dispersion equation.

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REFER ALSO TO CITATION(S) 41498, 41500, 41621, 41709, 42716, 42883

42347 **(BNL—39878) Effect of 2S and 2P states stark mixing for muon reactivation and x-ray intensities following the muon catalyzed fusion.** Takahashi, H. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 12p. (CONF-8705146—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011298.

From International symposium on muon catalyzed fusion, MCF-87; Leningrad, USSR (26 May 1987).

Kα-x-ray intensity and reactivation factors following muon catalyzed fusion are sensitive to the Stark mixing cross section between 2S and 2P states, but not Kβ and Kγ-x-ray intensities.

42348 **(CEA-CONF—8327) Mechanisms for associative ionization in He(5/sup 3p/)+He collisions at thermal energies.** Runge, S.; Pesnelle, A.; Perdrix, M.; Watel, G.; Cohen, J.S. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Inst. de Recherche Fondamentale (IRF)). Feb 1986. 7p. (CONF-860227—1). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752258.

From 5. symposium on atomic and surface physics; Obertraun, Austria (9 Feb 1986).

The aim of the present work was to determine the mechanisms responsible for the HMI in the presence of helium atoms; for that we have used a crossed beam experiment to obtain the energy dependence of the cross section which is generally an efficient test of the interactions taking place during the collision.

42349 **(CEA-CONF—8328) Correlation and relativistic effects in atoms and small molecules.** Baylis, W.E. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Inst. de Recherche Fondamentale (IRF)). Sep 1985. 32p. (CONF-8509387—2). NTIS (US Sales Only), PC A03/MF A01. File Number DE87752257.

From 12. summer school on quantum optics; Frombork, Poland (2 Sep 1985).

Calculations on atoms are used to illustrate the importance of correlation and relativistic effects and the success which can be achieved with a polarization model in combination with a multiconfiguration treatment for atoms with more than one electron in the valence shell. Finally, we will extend the simple oscillator model to interacting atoms and thereby find that there is an important core-polarization correction which reduces the molecular dispersion interaction.

42350 **(CONF-861114—56) Beam developments for the Harwell microprobe system.** Read, P.M.; Cookson, J.A.; Alton, G.D. (Oak Ridge National Lab., TN (USA); UKAEA Atomic Energy Research Establishment, Harwell. Nuclear Physics Div.). 1986. Contract AC05-84OR21400. 8p. NTIS, PC A02. File Number DE87011685.

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

A consequence of the rapid development of micron and submicron size electronic devices is the diminished applicability of high energy ion microprobes with their present resolution limitations to the study of such components. Although submicron beams have been reported the available beam current is barely sufficiently for PIXE and is not adequate for RBS. This lack of lateral resolution is due to low beam brightness at the microprobe object and aberrations in the focusing elements. As part of a program to address these problems the Harwell microprobe lens has been relocated on a new 5 MV Laddertron accelerator. The increased brightness and improved stability of this facility has so far led to a reduction in beam size from 3 x 3 μm^2 to about 2 x 2 μm^2. The feasibility of using a liquid metal ion source has been examined with a view to achieving more substantial increases in brightness. While such sources have brightness approximately 10^5 times greater than conventional gaseous sources the highly divergent nature of the beam presents problems for the beam transport system. The use of a liquid metal source on the accelerator has been successfully demonstrated but it indicates the need for a special low aberration injection lens if brightness is to be maintained.

42351 **(CONF-870595—2) High-precision laser and rf spectroscopy of atomic, molecular, and slow ion beams.** Childs, W.J.; Goodman, L.S.; Sen, A. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 3p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011421.

From DOE/BES atomic physics program workshop; Cambridge, MA, USA (21 May 1987).

Interesting new results were obtained in 1986 in high-precision Laser-rf studies of neutral atoms, neutral molecules, and atomic ions. Because of their novelty, the ionic results are discussed at some length and then summarize briefly results in the other two areas.

42352 **(DOE/ER/13405—T1) [Picosecond CO_2 laser interactions with polyatomic molecules]: Progress report.** (State Univ. of New York, Stony Brook (USA). Research Foundation). 1987. Contract FG02-85ER13405. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012072.

During the past year, the infrared absorption spectra of molecules in the highly vibrationally excited states were obtained using the picosecond CO_2 laser system. The spectra were found to depend on the degree of excitation and the probe pulse duration. The intramolecular energy relaxation time can be inferred from this pulse duration dependence effect. This is the only study of this kind ever performed that yield dynamical result from a static spectral measurement with a variable interaction time. A Bloch equation model was used to explain the change in the absorption cross section as a function of the pulse duration at line center. The intensity dependence of the multiphoton excitation process can be explained completely by this calculation. Some initial results were also obtained on the UV-IR double resonance experiment. Using CrO_2Cl_2 as the sample, the time resolution of the non-resonant multiphoton ionization signal were obtained. Preliminary analysis shows that the signal decay was due to collisional deactivation of the initial electronic excitation.

42353 **(IAE—4265/1) Possibility of measurement of the Weinberg angle in the pair conversion of the 2s1/2 -> 1s1/2 μ^- mesoatom transition.** Grechukhin, D.P.; Romanov, S.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1986. 28p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. File Number DE87702729.

The possibility of determination of the sin² Θ/sub W/ parameter (where Θ/sub W/ is Weinberg angle) according to the P-odd correlations in spectra of pair conversion electrons and positrons of the $2S_1/2$ -> $1S_1/2$ μ^- mesoatom transition of the range $23 \leq Z \leq 42$ (Z is the nucleus charge) is studied. The scale estimations of intensities of accompanying background processes hindering reliable theoretical interpretation of P-odd effects are made. It is shown that arrangement of the experiment on measuring sin²Θ/sub W/ at accuracy of several per cent order in the process of pair conversion is apparantly inexpedient. 26 references, 7 figures, 5 tables.

42354 **(IC—86/263) Application of diagonalization approximation to the n=3 resonant photoionization of helium-like systems.** Wague', A. (International Centre for Theoretical Physics, Trieste (Italy)). Sep 1986. 23p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702579.

A further analysis of diagonalization approximation is made in the multichannel resonant photoionization of two-electron systems near the n=3 threshold of reduced hydrogenic ion. The authors have obtained excitation energies partial and total eigenwidths of a few ^{1}p/sup (-)/ and ^{3}p/sup (-)/ low-lying resonances in He and some He-like ions. A comparison of calculations with experimental data and with the results obtained using other approximations-like close-coupling calculations, enables one to assess the applicability of the diagonalization approximation for solving the multichannel resonant photo-ionization problem. 27 references, 1 figure, 5 tables.

42355 **(IC—86/290) Energy levels and dipole oscillator strengths in the magnesium isoelectronic sequence.** El-Sherbini, T.M.; Mansour, H.M.M.; Farrag, A.A.; Rahman, A.A. (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1986. 21p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702590.

Energy levels of the $1S^22S^22p^63sns$ ($^3S,^1S$); n=4-7, $1S^22S^22p^63Snp(^3p,^1p)$; n=3-7, $1S^22S^22p^63Snd(^3D,^1D)$; n=3-7 and $1S^22S^22p^63Snf(^3F,^1F)$; n=4-7 excited states of MgI sequence are calculated using single configuration Hartree-Fock method. Hence the results are used in evaluating dipole oscillator strengths for the $3Sns(^1S)$-$3Smp(^1p)$; (n,m=3-7), $3Snp(^1p)$-$3Smd(^1D)$; (n=4-7, m=3-6) single transitions and the $3Sns(^3S)$-$3Smp(^3p)$; (n=4-7, m=3-7), $3Snp(^3p)$-$3Smd(^3D)$; (n=4-7, m=3-6) triplet transitions in the isoelectronic sequence. The results are comparable with the experimental values. Lifetimes of the upper $3Sns(^3S,^1S)$; (n=4-7) and $3Snp(^3p,^1p)$; (n=3-7) excited states are obtained and compared with the available experimental data. 22 references, 3 figures, 12 tables.

42356 **(INIS-BR—666) Study of e^-V alkaline atom inelastic collisions with the Glauber approxmation.** Bielschowsky, C.E. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1984. 198p. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. File Number DE87702774.

Glauber's approximation is used to study discrete excitations in alkali atoms by electron impact. The interaction between the incident electron and the core electrons and (N-1) nuclear charges is described through an Yukawa-like potential. Analitical expressions for m^2S and m^2P excitations are obtained, as well as numerical results for several excitations processes in alkali atoms.

42357 **(INIS-BR—669) Proceedings of the 4. National Meeting of Moessbauer Spectroscopy.** (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1986. 63p. (In Portuguese). (CONF-8512132—). NTIS (US Sales Only), PC A04/MF A01. File Number DE87702777.

From 4. national meeting of Moessbauer spectroscopy; Rio de Janeiro, Brazil (11 Dec 1985).

The electronic structure and physical properties of crystals, meteorites, alloys and salts using Moessbauer effect and X ray diffraction are studied.

42358 **(INIS-mf—10926) Anisotropy in the simultaneous excitation of two colliding atoms to various substate combinations. A study of the simultaneous excitation of both collision partners in He-He and He-Ne collisions.** Moorman, L. (Rijksuniversiteit Utrecht (Netherlands)). 21 Jan 1987. 152p. NTIS (US Sales Only), PC A08/MF A01. File Number DE87702793.

In this thesis double-atom excitation (DAE) processes in atomic collision experiments are studied by measuring the angular correlation of two coincident photons emitted by both excited collision particles. The analytical expression for the angular correlation function is derived which contains as adjustable parameters the various (complex) excitation amplitudes integrated over all scattering angles. The He+He system is investigated, for projectile energies between 0.5 and 3.5 keV, in which both particles are excited simultaneously to the 2^1P state. The relation between photon correlations and atomic state correlations is investigated and the density matrix elements are calculated for a statistical distribution of the excited atomic substates into which a certain symmetry is incorporated. Collisions between metastable and groundstate He atoms are considered. Single-photon spectra are presented and compared with spectra from the He+He collision system. Coincidence measurements were performed on these collision systems to study possible double-atom excitations. Coincidences between two ultraviolet as well as an ultraviolet and a visible photon were measured. Also a measurement is reported of the relative population of the magnetic substates of the 3^1D state of helium. Coincidence measurements on two ultraviolet photons emitted upon Ne-Ne and He-Ne collisions are described and the double-atom excitations for these systems are studied. For Ne+Ne no coincidence peaks were found. For He+Ne double-atom excitation was observed and from the measured angular correlations the corresponding density matrix elements for some kinetic energies of the projectile.

42359 (JINR—D-10-11-84-818, pp 178-180) **Newton iterative scheme with perturbed operators in a problem on calculation of mesic molecule energy levels.** Vinitskij, S.I.; Gocheva, A.D.; Puzynina, T.P.; Puzynin, I.V. 1985. (In Russian). NTIS (US Sales Only), PC A16/MF A01. File Number DE87780164. (CONF-8309402—).

From 5. international meeting on problems of mathematical simulation, programming, and mathematical methods for solving the physical problems; Dubna, USSR (20 Sep 1983).

Within the frames of the three-body problem with Coulomb interaction the question of determining the energy levels of mesic molecules is discussed. The calculations use the Newton iterative scheme. The calculation results for the spectral parameter λ=-2 Mϵ/sub Jv/ of the ground states of μ mesic molecules pdμ, ppμ and exotic e/sup -/e/sup -/e/sup +/ system are given (ϵ/sub Jv/ is the energy levels of the quantum-mechanical three-particle system with the reduced mass M in states characterized by the rotational J, oscillatory v and magnetic quantum numbers). 3 refs.

42360 **(KFK—4176) Relativistic calculations of level energies of a high-Z atom.** Yabe, Takashi; Goel, B. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik). Mar 1987. 21p. NTIS, PC E07; Available from NTIS as TIB/B87-07775.

Level energies are calculated using relativistic and non-relativistic Hartree-Fock-Slater (RHFS and HFS) models for an Au-atom in various charge states. The level splitting due to orbital angular momentum and electron spin is investigated in comparison to a simple analytical model. This model is based on shell model and is an extension of previous such models in that it takes overlap of orbitals into account. The model can satisfactorily replicate the results of RHFS and HFS calculations. This model can be applied to other atoms as well.

42361 **(LA-UR—87-1967) Charged particle beam divergence measurements using transition radiation.** Iversen, S.G.; Ladish, J.S.; Caldwell, S.E.; Rule, D.W.; Fiorito, R.B. (EG and G Energy Measurements, Inc., Goleta, CA (USA). Santa Barbara Operations; Los Alamos National Lab., NM (USA); Naval Surface Weapons Center, Silver Spring, MD (USA). White Oak Lab.). 1987. Contract W-7405-ENG-36. 4p. (CONF-870302—232). NTIS, PC A02. File Number DE87011780.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Developed is single and double foil techniques to measure current density, energy, and divergence of intense relativistic charged particle beams from the transition radiation produced at a foil-vacuum interface. Single foil optical transition radiation (OTR) measurements have been made using a high intensity beam of 10 to 25 MeV electrons from the EG & G/EM linac, in which the entire OTR distribution is captured with an imaging system. Here we describe the results of similar experiments utilizing a two-foil interferometer, which has potential for making high precision energy and emittance measurements of very cold beams.

42362 **(PNL-SA—13786) High-efficiency, high abundance sensitivity RIMS by double-resonance excitation with cw-lasers.** Bushaw, B.A.; Cannon, B.D.; Gerke, G.K.; Whitaker, T.J. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1986. Contract AC06-76RL01830. 7p. (CONF-8609132—16). NTIS, PC A02. File Number DE87012060.

From Resonance ionization spectroscopy and its application; Swansea, UK (7 Sep 1986).

Two single-frequency cw dye lasers and a medium power infrared cw laser have produced efficient, highly selective ionization of barium isotopes in the source region of a quadrupole mass spectrometer. Laser ionization efficiencies of $>5\%$ have been observed while maintaining isotopic selectivities of $\sim 10^5$.

42363 **(UCRL—96778) Measurement of atomic oscillator strengths in ytterbium by observation of coherent Rabi oscillations of excited-state populations.** Haynam, C.A.; Comaskey, B.J.; Worden, E.F.; Paisner, J.A. (Lawrence Livermore National Lab., CA (USA)). 1987. Contract W-7405-ENG-48. 22p. (CONF-8706128—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011326.

From 8. international conference on laser spectroscopy; Are, Sweden (22 Jun 1987).

Two methods have been used to measure the oscillator strength of the transition between the ground and 17,992 cm^{-1} level in ^{174}Yb. The first technique involves exciting the transition with a laser pulse that is nearly time-bandwidth limited, of uniform intensity, and has a reproducible shape from shot to shot. The population left in the excited state after the pulse varies sinusoidally with a period that depends on the integral over time of the electric field amplitude and the transition oscillator strength. These are the Rabi oscillations that are predicted by application of the Schrodinger equation to the two-level atom. The second method involves observation of the polarization rotation of a set of degenerate sublevels brought about by a light-shift laser. One sublevel (m/sub j/ = 0) of the J = 1 level at 17,992 cm^{-1} is populated by a linearly polarized laser. A second copropagating light-shift laser, which is linearly polarized at an angle to the first laser, is tuned between 7.5 and 30 GHz off-resonance with the transition. The light-shift laser causes population to be promoted into the m/sub j/ = +-1 levels through the virtual J = 0, m/sub j/ = 0 level. Two linearly polarized photoionizing lasers photoionize the population only from the m/sub j/ = +-1 levels. The photoion signal oscillates cosinusoidally with a period that depends only on the integrated pulse intensity, the laser detuning, and the transition oscillator strength. Finally, polarization selectivity has been shown experimentally to allow selective photoionization of the odd isotopes of ytterbium using broadband lasers.

42364 **Krypton dimers: Resonance-enhanced MPI via gerade states in the region of atomic $4p^5 5p$ configurations.** Echt, O.; Cook, M.C.; Castleman A.W. Jr. (Department of Chemistry, The Pennsylvania State University, University Park, Pennsylvania 16802). *Journal of Chemical Physics;* **87**: No. 6, 3276-3280(15 Sep 1987).

The two-photon resonant absorption of Kr₂(¹Σ⁺/sub g/) has been measured via (2+1) multiphoton ionization studies in the energy range 91 750—92 420 cm^{-1}. Two vibrational progressions are observed. One of them is attributed to the atomic $4p^5(^2P_3$/sub //₂)5p[5/2]₂ state, implying D/sup '/₀ = 220 cm^{-1}. A long progression is assigned as correlating with the $4p^5(^2P_3$/sub //₂)5p[3/2]₂ state, implying $D_0 \geqq 1480$ cm^{-1}.

42365 **Photoionization dynamics of H_2 C ¹Pi/sub u/: Vibrational and rotational branching ratios.** O'Halloran, M.A.; Pratt, S.T.; Dehmer, P.M.; Dehmer, J.L. (Argonne National Laboratory, Argonne, Illinois 60439). *Journal of Chemical Physics;* **87**: No. 6, 3288-3298(15 Sep 1987). Contract W-31-109-ENG-38.

Angle-integrated, rotationally resolved photoelectron spectra were determined for three-photon resonant, four-photon (3+1) ionization of H_2 via the C ¹Pi/sub u/, v' = 0—4 intermediate levels using a magnetic bottle electron spectrometer. The results confirm and extend our previous angle-resolved results obtained using a hemispherical electron energy analyzer. As predicted by both Franck—Condon factors and recent ab initio Hartree—Fock level calculations, ionizing transitions in which the vibrational level of the resonant intermediate state is preserved in the ion are most probable; however, large deviations from theoretical expectations are observed for photoionization of all intermediate levels. These deviations take the form of a progressive broadening of the ionic vibrational distribution as the vibrational level of the resonant intermediate state is increased. The rotational branching ratios also exhibit systematic variations with both the vibrational level of the C ¹Pi/sub u/ state and the vibrational level of the ion. Photoelectron signal from ionization of electronically excited atomic hydrogen produced in the photodissociation of H_2 C ¹Pi/sub u/ is also observed.

42366 **Binary diffusion coefficients for the systems He^4—He^3, He^4—D_2, He^4—H_2, He^3—D_2, He^3—H_2, and H_2—D_2 from 273 to 320 K: Tests of several potential functions.** Dunlop, P.J.; Bignell, C.M.; Taylor, W.L.; Meyer, B.A. (Department of Physical and Inorganic Chemistry, University of Adelaide, Adelaide, South Australia, 5001). *Journal of Chemical Physics;* **87**: No. 6, 3591-3593(15 Sep 1987).

Diffusion coefficients are reported for the six binary systems which can be formed from the components He^4, He^3, D_2, and H_2. The results are used to test the assumption that the potential function for a given system is independent of the isotopic nature of each component.

42367 **Nuclear quadrupole structure of potassium hydroxide in the 32 GHz microwave region.** Raw, T.T.; Yamamura, T.; Gillies, C.W. (Department of Chemistry, Rensselaer Polytechnic Institute, Troy, New York 12180-3590). *Journal of Chemical Physics;* **87**: No. 6, 3706-3707(15 Sep 1987).

A high temperature Stark and radiofrequency-microwave double resonance spectrometer was used to observe the nuclear quadrupole structure of the J = 2←1 transition of ^{39}KOH in a number of vibrational states. First order analysis of the hyperfine components gave nuclear quadrupole coupling constants of eQq = -7.23 (29) MHz for the (00^00) state, eQq = -7.16 (33) MHz for the (10^00) state, and eQq = -7.29 (37) MHz for the (01^10) state.

42368 **Adiabatic invariance treatment of hitting collisions between ions and symmetrical top dipolar molecules.** Bates, D.R.; Morgan, W.L. (Department of Applied Mathematics and Theoretical Physics, The Queens University of Belfast, Belfast BT7 1NN, Northern Ireland, United Kingdom). *Journal of Chemical Physics;* **87**: No. 5, 2611-2616(1 Sep 1987).

The adiabatic invariance method of calculating the rate coefficient k/sub D/(J,K) for hitting collisions between ions and symmetrical top dipolar molecules in level (J,K) is formulated. The rate coefficient for a particular quantum level does not depend on the rotational constant A of the symmetrical top molecule. This facilitates parametrization of the results. Representative results on NH_3 and CH_3F including the thermal average k-bar/sub D/ are presented. A formula that Su and Chesnavich obtained for linear molecules reproduces k-bar/sub D/ for NH_3 and CH_3F quite well. Measured rate coefficients k/sub r/ for reactive collisions between several species of ion and NH_3 yield collision efficiencies k/sub r// k-bar/sub D/ that are rather less than unity and temperature independent in the low temperature region. Corresponding results involving H_2O suggest that the linear molecule formula is useful even for an asymmetrical top molecule.

42369 **Merit of ground-state electronegativities; a reply to "Comments on 'Introduction to the chemistry of fractionally charged atoms: Electronegativity' ".** Lackner, K.S.; Zweig, G. (Theory Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *D: Particles and Fields;* **36**: No. 5, 1562-1569(1 Sep 1987). Contract W-7405-ENG-36.

The arguments presented in the Comment by Liebman and Huheey are shown to be incorrect. The operational equivalence of Mulliken ground-state electronegativities and Pauling electronegativities is demonstrated for neutral atoms. It is shown that ground-state electronegativities and valence-state electronegativities for both neutral atoms and ions are also operationally equivalent. A single electronegativity scale based on Mulliken ground-state electronegativities may therefore be used for neutral atoms, ions, and fractionally charged atoms, as originally implied in the paper by Lackner and Zweig.

42370 **Hyperfine structure of /sup 147,149/Sm II by collinear laser—ion-beam spectroscopy.** Young, L.; Childs, W.J.; Berry, H.G.; Kurtz, C.; Dinneen, T. (Physics Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review* [*Section*] *A: General Physics;* **36**: No. 5, 2148-2154(1 Sep 1987). Contract W-31-109-ENG-38.

Collinear laser—ion-beam spectroscopy has been used to measure the hyperfine structure (hfs) of nine metastable even-parity levels (E<15000 cm/sup -1/) and nine odd-parity levels (EV32000 cm/sup -1/) in /sup 147,149/Sm II. The mass resolution of 1 part in 350 eliminates spectral congestion due to overlapping lines from neighboring isotopes. The kinematic compression of the Doppler width is essential to obtain the necessary spectral resolution (approximately 20 MHz) to completely resolve hfs. An optical pumping scheme is used to differentiate the upper and lower levels of the observed transitions. The resulting magnetic dipole hfs constants, A, for the even-parity states arising from the $4f^6(^7F)5d$ configuration that are nominally more than pure 90% LS coupled have been analyzed in terms of Sandars-Beck effective-operator theory. The analysis shows that these levels actually contain substantial admixture of open-shell s electrons.

42371 **Confined thermal multicharged ions produced by synchrotron radiation.** Church, D.A.; Kravis, S.D.; Sellin, I.A.; O, C.S.; Levin, J.C.; Short, R.T.; Meron, M.; Johnson, B.M.; Jones, K.W. (Physics Department, Texas A&M University, College Station, Texas 77843). *Physical Review* [*Section*] *A: General Physics;* **36**: No. 5, 2487-2490(1 Sep 1987).

Synchrotron x rays have been used to produce a confined multicharged ion gas near room temperature. Comparison of charge-state-number observations characteristic of ion formation and of ion storage, together with measurements of Ar-to-Ar/sup q/ + electron-transfer rate coefficients, provide information to estimate time constants for relaxation to thermal equilibrium and other stored-ion properties important to further development of the technique.

42372 **Formation of protonium in collisions of antiprotons with H and H^-.** Cohen, J.S. (Theoretical Division, Los Alamos National Laboratory, University of California, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *A: General Physics;* **36**: No. 5, 2024-2030(1 Sep 1987).

Cross sections for formation of protonium (pp-bar) in low-energy collisions of antiprotons with hydrogen atoms (H) and negative hydrogen ions (H^-) are calculated using the classical-trajectory Monte Carlo (CTMC) method. Full four-body dynamics is performed for p-bar+H^-. Previously unpredicted differences between p-bar+H and p-bar+H^- collisions, stemming from the dynamics of the weakly bound electron in H^-, are exhibited. A maximum protonium formation cross section of nearly 2 A^2 for p-bar+H^- is found, smaller than previous theoretical estimates, but the reaction window is found to extend to higher energies. The electron stripping cross section for p-bar+H^- collisions is also calculated and yields results in agreement with our previous three-body CTMC calculation and with a very recent experimental determination. The implications of these results for experiments with corotating beams of p-bar and H^- are discussed.

42373 **Ionization rate coefficients and induction times in nitrogen at high values of E/N.** Hays, G.N.; Pitchford, L.C.; Gerardo, J.B.; Verdeyen, J.T.; Li, Y.M. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Physical Review [Section] A: General Physics;* **36**: No. 5, 2031-2040(1 Sep 1987). Contract AC04-76DP00789.

Electron-impact ionization rate coefficients in nitrogen at values of E/N, the ratio of the electric field to the neutral density, up to 12 000 Td (1 Td = 10/sup -17/ V cm^2), are reported. In addition, we report experimental measurements of the ionization induction time, the time during the early portion of an applied electric field when the electron energy distribution function is transient and the plasma is characterized by nonexponential growth of the electron density. For nitrogen, we show that the induction period is approximately equal to the inverse of the ionization frequency for a large E/N range. Time-dependent Boltzmann calculations of the electron energy distribution function yield instantaneous ionization rates that are in good agreement with both the measured ionization rates and the induction period. The measurements were made in an electrodeless cell contained in an S-band waveguide immersed in a dc magnetic field and subjected to a pulsed rf electric field at cyclotron resonance. We show that our measurements are equivalent to experiments in dc electric fields; the equivalent dc electric field strength being uniquely related to the rf electric field strength. The use of an rf field for these high-E/N measurements circumvents complications that would be introduced by electrode effects. This is the first direct measurement of ionization rates at these extreme values of E/N.

42374 **Interplay of nuclear and atomic physics in ion-atom collisions.** Heinz, U. (Brookhaven National Lab., Upton, NY, USA). *Reports on Progress in Physics;* **50**: No. 2, 145-146(Feb 1987).

The paper reviews the interplay between atomic and nuclear interactions in collisions between light and heavy ions. A general theoretical description is outlined including: the scattering problem, basis expansion, coupled channel equations for the nuclear relative motion, the semiclassical approximation, and the fully quantum mechanical treatment. An overview is given of the experimental data on nuclear-atomic interference. These data are taken from experiments on nuclear scattering resonance, decay studies, and include compound nuclear times from x-ray scattering studies, and delta-electron and positron production in energetic very-heavy-ion collisions.

42375 **Spectra and electronic structure of free actinide atoms and ions.** Fred, M.S. (Argonne National Lab., IL, USA). pp 1196-1234 of Chemistry of the actinide elements. Vol. 2. 2. Ed . Katz, J.J.; Morss, L.R.; Seaborg, G.T. (eds.). London, England; Chapman and Hall (1986).

Price Pound 110.00.

A resume is given of the experimental data on energy levels of isolated actinide neutral atoms and ions derived from analysis of the spectra of the vapour phase at low density. Typically, a neutral actinide has a thousand experimental levels and the ionized state somewhat fewer. Most levels can be identified only by comparison with theoretical calculations using appropriate parameters. The theoretical description of the term structure is outlined and the fitting of parameters discussed. The lowest level of all known actinide electron configurations is listed together with isotope shifts and hyperfine structure widths. Some interpretation of the data in terms of general trends and the implications for actinide chemistry is attempted.

42376 **Optical spectra and electronic structure of actinide ions in compounds and in solution.** Carnall, W.T.; Crosswhite, H.M. (Argonne National Lab., IL, USA). pp 1235-1277 of Chemistry of the actinide elements. Vol. 2. 2. Ed . Katz, J.J.; Morss, L.R.; Seaborg, G.T. (eds.). London, England; Chapman and Hall (1986).

Price Pound 110.00.

A feature of the actinide elements is the stability of the f orbitals against changes in the ionic environment and a consequent relative insensitivity of actinide spectra to such changes. Free-ion calculations can be used, therefore, to assist in the interpretation of the spectra arising from condensed phases. The theoretical model for free-ions as applied to f-element spectra is outlined in this review and the modifications required to take account of the crystal field in a condensed-phase medium are discussed. Analysis of the electronic structure of other valence states is also considered. This is much more tentative although the spectra of actinide compounds and solutions involving states other than the trivalent are well known.

42377 **Magnetic properties.** Edelstein, N.M.; Goffart, J. (Lawrence Berkeley Lab., CA, USA; Liege Univ., Belgium. Inst. de Chimie). pp 1361-1387 of Chemistry of the actinide elements. Vol. 2. 2. Ed . Katz, J.J.; Morss, L.R.; Seaborg, G.T. (eds.). London, England; Chapman and Hall (1986).

Price Pound 110.00.

The magnetic properties of actinide ions and compounds arise from the spin and orbital angular momentum of the impaired electrons. The classic work of Van Vleck relates molar susceptibility to the energies of the levels of the ion or molecule; thus magnetic data can be used to test or determine information about energy levels and their wavefunctions. This review deals with magnetic susceptibility, electron paramagnetic resonance and other magnetic characteristics for selected electronic configurations and actinide ions with the emphasis on recent measurements. References to earlier reviews, which together give a broader coverage, are included, however.

42378 **Quark dynamics in the πNN system.** Lee, T.S.H. (Physics Div., Argonne National Lab., Argonne, IL 60439). pp 371-388 of Few-body methods: Principles and applications. Lim, T.K.; Bao, C.G.; Hou, D.P.; Huber, H.S. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8508100—).

From International symposium on few-body methods and their applications in atomic, molecular and nuclear physics and chemistry; Nanning, China (4 Aug 1985).

The recently developed πNN theory based on quark dynamics is reviewed. The intermediate energy nuclear reactions, induced by pions, nucleons, electrons or heavy-ions, are characterized by the production or or absorption of on-mass-shell pions. Therefore, a theoretical approach to the problem should start from a theory (called the πNN theory in the literature) which can describe simultaneously all of the following processes $\pi N \rightarrow \pi N$ (300MeV < E/sub L/) $NN \rightarrow NN$ (1000 MeV < E/sub L/)$\rightarrow \pi NN$ $\pi d \rightarrow \pi d$ (300 MeV < E/sub L/)$\rightarrow \pi NN \rightarrow NN$. In addition, I must face the fact that at this higher energy, two colliding baryons are more likely to overlap and the effect of their internal quark structure may be important. In this talk the author discusses a general πNN theory which has been constructed according to our present understanding of the quark dynamics.

6404 Fluid Physics

REFER ALSO TO CITATION(S) 42333

42379 **(AD-A—180218/0/XAB) Intense xuv (extreme ultraviolet) radiation sources. Annual report (Final), 1 August 1983-31 July 1985.** Ginter, M.L. (Maryland Univ., College Park (USA). Inst. for Physical Science and Technology). 31 Jul 1985. 71p. NTIS, PC A04/MF A01.

Characterizations were performed of the extreme-ultraviolet output of the laser-produced plasma system in the 30-1200 A region. The system was used for preliminary studies in high-resolution spectroscopy in the grazing incidence region and in soft x-ray microlithography. Contents include: Laser-Produced Plasma Light Sources; XUV and Soft X-Ray Radiation from Laser-Produced Plasmas as Laboratory Spectroscopic Source; Laser-Produced Plasma Light Sources for High-Resolution XUV and VUV Spectroscopy; Soft-X-Ray Lithography using Radiation From Laser-Produced Plasma; Laser-Produced Plasma Light Sources for High Resolution XUV and VUV Spectroscopy; High-Resolution Spectra of Laser-Plasma Light Sources in the Grazing-Incidence Region; and Photometric Investigation of a Laser-Produced Plasma VUV Light Source.

42380 **(DOE/ER/10497—T1) Transport and phase equilibria in multicomponent fluids: Final report.** Kincaid, J.M. (National Bureau of Standards, Washington, DC (USA). Thermophysics Div.). Jul 1986. Contract AT01-79ER10497. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011011.

This report highlights the results of fluid flow research projects supported by the Office of Basic Energy Sciences during the three year contract period 1 February 1984 through 31 January 1987.

42381 (INIS-mf—10918, pp 41-42) **Reconsideration of the structure of ionizing shock waves.** Kaniel, A.; Igra, O.; Ben-Dor, G.; Mond, M. (Ben-Gurion Univ. of the Negev, Beersheba, Israel). 1986. NTIS (US Sales Only), PC A03/MF A01. File Number DE87780149. (CONF-8606316—Absts.).

From 6. Mach reflection symposium; Beer Sheva, Israel (29 Jun 1986).

42382 (INIS-mf—10918, pp 6) **Survey on optical visualization methods.** Reichenbach, H. (Ernst-Mach-Institute, Freiburg, Germany, F.R.). 1986. NTIS (US Sales Only), PC A03/MF A01. File Number DE87780149. (CONF-8606316—Absts.).

From 6. Mach reflection symposium; Beer Sheva, Israel (29 Jun 1986).

42383 (INIS-mf—10918, pp 7-8) **Moire Deflectometry: A new approach for wind tunnel and shock tube diagnostics.** Kafri, O.; Keren, E.; Livnat, A. (Rotlex Optics, Beersheba, Israel). 1986. NTIS (US Sales Only), PC A03/MF A01. File Number DE87780149. (CONF-8606316—Absts.).

From 6. Mach reflection symposium; Beer Sheva, Israel (29 Jun 1986).

42384 (INIS-mf—10918, pp 9-10a) **Reflection of a planar shock wave over a double wedge.** Dewey, J.M.; Ben-Dor, G.; Takayama, K. (Victoria Univ., British Columbia, Canada; Ben-Gurion Univ. of the Negev, Beersheba, Israel; Tohoku Univ., Sendai, Japan. Inst. of High Speed Mechanics). 1986. NTIS (US Sales Only), PC A03/MF A01. File Number DE87780149. (CONF-8606316—Absts.).

From 6. Mach reflection symposium; Beer Sheva, Israel (29 Jun 1986).

42385 (INIS-mf—10918, pp 12-13) **Shock conditions for unsteady mach-reflection.** Handke, E.; Obermeier, F. (Goettingen Univ., Germany, F.R.). 1986. NTIS (US Sales Only), PC A03/MF A01. File Number DE87780149. (CONF-8606316—Absts.).

From 6. Mach reflection symposium; Beer Sheva, Israel (29 Jun 1986).

42386 (INIS-mf—10918, pp 5) **Some aspects of shock-wave research.** Glass, I.I. (Toronto Univ., Ontario, Canada. Inst. for Aerospace Studies). 1986. NTIS (US Sales Only), PC A03/MF A01. File Number DE87780149. (CONF-8606316—Absts.).

From 6. Mach reflection symposium; Beer Sheva, Israel (29 Jun 1986).

42387 (INIS-mf—10918, pp 21-22) **Flow field developed behind spherical shock waves propagation into a mixture of a gas and solid particles.** Rakib, Z.; Ben-Dor, G.; Mond, M.; Igra, O. (Tel Aviv Univ., Israel. Dept. of Mathematical Sciences; Ben-Gurion Univ. of the Negev, Beersheba, Israel). 1986. NTIS (US Sales Only), PC A03/MF A01. File Number DE87780149. (CONF-8606316—Absts.).

From 6. Mach reflection symposium; Beer Sheva, Israel (29 Jun 1986).

42388 (INIS-mf—10918, pp 25-27) **Shock transition over preforated wedges.** Takayama, K.; Onodera, H.; Itoh, K. (Tohoku Univ., Sendai, Japan. Inst. of High Speed Mechanics). 1986. NTIS (US Sales Only), PC A03/MF A01. File Number DE87780149. (CONF-8606316—Absts.).

From 6. Mach reflection symposium; Beer Sheva, Israel (29 Jun 1986).

42389 (INIS-mf—10918, pp 28-29) **Influence of surface roughness on the transition from regular to mach reflection in pseudo-steady flows.** Mazor, G.; Ben-Dor, G.; Igra, O. (Ben-Gurion Univ. of the Negev, Beersheba, Israel). 1986. NTIS (US Sales Only), PC A03/MF A01. File Number DE87780149. (CONF-8606316—Absts.).

From 6. Mach reflection symposium; Beer Sheva, Israel (29 Jun 1986).

42390 (INIS-mf—10918, pp 37-38) **Experiments on the propagation and stability of converging cylindrical shock waves.** Kleine, H.; Gronig, H. (Stosswellenlabor, RWTH Aachen, Germany, F.R.). 1986. NTIS (US Sales Only), PC A03/MF A01. File Number DE87780149. (CONF-8606316—Absts.).

From 6. Mach reflection symposium; Beer Sheva, Israel (29 Jun 1986).

42391 (INIS-mf—10918, pp 39-40) **Analysis of mach reflection by the method of power series expansions.** Book, D.L. (Naval Research Lab., Washington, DC, USA). 1986. NTIS (US Sales Only), PC A03/MF A01. File Number DE87780149. (CONF-8606316—Absts.).

From 6. Mach reflection symposium; Beer Sheva, Israel (29 Jun 1986).

42392 (INIS-mf—10918, pp 11) **Calculations of double wedge reflections.** Needham, C.E. (S-Cubed, Maxwell Labs., Albuquerque, NM, USA). 1986. NTIS (US Sales Only), PC A03/MF A01. File Number DE87780149. (CONF-8606316—Absts.).

From 6. Mach reflection symposium; Beer Sheva, Israel (29 Jun 1986).

42393 (INIS-mf—10918, pp 15-16) **Viscosity influence on mach-type shock wave reflection.** Schmidt, B. (Karlsruhe Univ., T.H., Germany, F.R.). 1986. NTIS (US Sales Only), PC A03/MF A01. File Number DE87780149. (CONF-8606316—Absts.).

From 6. Mach reflection symposium; Beer Sheva, Israel (29 Jun 1986).

42394 (INIS-mf—10918, pp 17) **Reconsideration of the three shock theory for a pseudo-steady mach reflection.** Ben-Dor, G. (Ben-Gurion Univ. of the Negev, Beersheba, Israel). 1986. NTIS (US Sales Only), PC A03/MF A01. File Number DE87780149. (CONF-8606316—Absts.).

From 6. Mach reflection symposium; Beer Sheva, Israel (29 Jun 1986).

42395 (INIS-mf—10918, pp 20) **Numerical investigation of nonstationary propagation of strong planar and spherical shock waves in a dusty gas by the random choice method.** Elperin, T.; Igra, O.; Ben-Dor, G. (Ben-Gurion Univ. of the Negev, Beersheba, Israel). 1986. NTIS (US Sales Only), PC A03/MF A01. File Number DE87780149. (CONF-8606316—Absts.).

From 6. Mach reflection symposium; Beer Sheva, Israel (29 Jun 1986).

42396 (INIS-mf—10918, pp 23-24) **Shock reflection processes influenced by wall and shock curvature.** Heilig, W.; Reichenbach, H. (Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forschung e.V., Freiburg im Breisgau, Germany, F.R. Ernst-Mach-Inst.). 1986. NTIS (US Sales Only), PC A03/MF A01. File Number DE87780149. (CONF-8606316—Absts.).

From 6. Mach reflection symposium; Beer Sheva, Israel (29 Jun 1986).

42397 (INIS-mf—10918, pp 30) **Note on the thermal nature of the triple-point of the three-shock wave confluence.** Ben-Dor, G.; Takayama, K.; Needham, C.E. (Ben-Gurion Univ. of the Negev, Beersheba, Israel; Tohoku Univ., Sendai, Japan. Inst. of High Speed Mechanics; S-Cubed, Maxwell Labs., Albuquerque, NM, USA). 1986. NTIS (US Sales Only), PC A03/MF A01. File Number DE87780149. (CONF-8606316—Absts.).

From 6. Mach reflection symposium; Beer Sheva, Israel (29 Jun 1986).

42398 (INIS-mf—10918, pp 31) **Hot spot at the triple-point in single wedge mach reflection.** Needham, C.E. (S-Cubed, Maxwell Labs., Albuquerque, NM, USA). 1986. NTIS (US Sales Only), PC A03/MF A01. File Number DE87780149. (CONF-8606316—Absts.).

From 6. Mach reflection symposium; Beer Sheva, Israel (29 Jun 1986).

42399 (INIS-mf—10918, pp 32-33) **Reconstruction of mach stem flows in blast waves.** McMillin, D.J.; Dewey, J.M. (Victoria Univ., British Columbia, Canada). 1986. NTIS (US Sales Only), PC A03/MF A01. File Number DE87780149. (CONF-8606316—Absts.).

From 6. Mach reflection symposium; Beer Sheva, Israel (29 Jun 1986).

42400 (INIS-mf—10918, pp 34-35) **Shock reflections in monotonically converging cavities.** Milton, B.E. (New South Wales Univ., Sydney, Australia). 1986. NTIS (US Sales Only), PC A03/MF A01. File Number DE87780149. (CONF-8606316—Absts.).

From 6. Mach reflection symposium; Beer Sheva, Israel (29 Jun 1986).

42401 (INIS-mf—10918, pp 36) **Shock wave reflection and reduction in a confined space.** Phan, K.C.; Stollery, J.L. (Cranfield Inst. of Tech., Bedford, UK). 1986. NTIS (US Sales Only), PC A03/MF A01. File Number DE87780149. (CONF-8606316—Absts.).

From 6. Mach reflection symposium; Beer Sheva, Israel (29 Jun 1986).

42402 **(INIS-mf—10918) Book of Abstracts of the 6th Mach Reflection Symposium.** Ben-Dor, G. (ed.). (Ben-Gurion Univ. of the Negev, Beersheba (Israel)). 1986. vp. (CONF-8606316—Absts.). NTIS (US Sales Only), PC A03/MF A01. File Number DE87780149.

From 6. Mach reflection symposium; Beer Sheva, Israel (29 Jun 1986).

Individual papers have been cataloged separately. (WRF)

42403 (JINR—D-10-11-84-818, pp 229-231) **PLAZMA problem-oriented package of applied programs.** Chernov, Yu.G.; Sakharov, B.B. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1985. (In Russian). NTIS (US Sales Only), PC A16/MF A01. File Number DE87780164. (CONF-8309402—).

From 5. international meeting on problems of mathematical simulation, programming, and mathematical methods for solving the physical problems; Dubna, USSR (20 Sep 1983).

The PLAZMA package of applied programs being an universal complex for calculating the properties of multicomponent heterogeneous plasma systems containing up to 700 components (gaseous and/or condensed) is described. The package is realized on the BESM-6 computer and it permits to calculate more than 60 parameters among which are the plasma temperature at the preset pressure, viscosity, thermal conductivity, thermodynamic potentials, sound velocity, thermal capacity, flow rate, electron concentration, conductance tensor components. The range of temperatures under investigation is 300-2000 K, and that of pressures under study is 0.001 bar - 20 kbar. 4 refs.

42404 **(LA—11009-MS) NASA-VOF3D: A three-dimensional computer program for incompressible flows with free surfaces.** Torrey, M.D.; Mjolsness, R.C.; Stein, L.R. (Los Alamos National Lab., NM (USA)). Jul 1987. Contract W-7405-ENG-36. 192p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE87011849.

Presented is the NASA-VOF3D three-dimensional, transient, free-surface hydrodynamics program. This three-dimensional extension of NASA-VOF2D will, in principle, permit treatment in full three-dimensional generality of the wide variety of applications that could be treated by NASA-VOF2D only within the two-dimensional idealization. In particular, it, like NASA-VOF2D, is specifically designed to calculate confined flows in a low g environment. The code is presently restricted to cylindrical geometry. The code is based on the fractional volume-of-fluid method and allows multiple free surfaces with surface tension and wall adhesion. It also has a partial cell treatment that allows curved boundaries and internal obstacles. This report provides a brief discussion of the numerical method, a code listing, and some sample problems.

42405 **Noise and compressibility in lattice-gas fluids.** Dahlburg, J.P.; Montgomery, D.; Doolen, G.D. (Department of Physics and Astronomy, Dartmouth College, Hanover, New Hampshire 03755). *Physical Review* [*Section*] *A: General Physics;* **36**: No. 5, 2471-2474(1 Sep 1987).

Computations are reported in which the hexagonal lattice gas is used to simulate two-dimensional Navier-Stokes shear flows. Limitations associated with noise in the initial loading and compressible effects associated with a velocity-dependent equation of state arise and interact with each other. A relatively narrow window in density and flow speed exhibits physical behavior.

42406 **Effect of thin film variations and transverse curvature on the shape of fingers in a Hele—Shaw cell.** Reinelt, D.A. (Department of Mathematics, Southern Methodist University, Dallas, Texas 75275). *Physics of Fluids;* **30**: No. 9, 2617-2623(Sep 1987).

The steady-state shape of a finger penetrating into a viscous fluid that fills the gap between two closely spaced parallel plates is examined. Boundary conditions that take into account variations in the thickness of the thin film and both transverse curvature (across the gap) and lateral curvature (along the interface edge) are applied at the leading edge of the interface. These interface conditions, derived from local solutions in the vicinity of the interface edge, depend on μU/sub n//T, where μ is the viscosity of the original fluid, U/sub n/ is the normal velocity of the interface edge, and T is the interfacial tension. They also depend on ϵ/R, where $\epsilon = b/a << 1$ is the ratio of gap width to cell width and aR is the lateral radius of curvature. The problem is solved by conformally mapping the domain to a circle. By expanding the solution in terms of analytic functions and satisfying the boundary conditions, the shape of the interface edge and finger width λ are determined. The agreement between numerical and experimental results is good and an

improvement over previous models. The relaxation of the film thickness is also discussed.

42407 **Shear-induced angular dependence of the liquid pair correlation function.** Hanley, H.J.M.; Rainwater, J.C.; Hess, S. (Thermophysics Division, National Engineering Laboratory, National Bureau of Standards, Boulder, Colorado 80303). *Physical Review [Section] A: General Physics;* **36**: No. 4, 1795-1802(15 Aug 1987).

A formal expansion in spherical harmonics or Cartesian tensors of the pair correlation function of a liquid subjected to a shear rate is discussed. Expressions for the coefficients to tensor rank 4 are evaluated via a nonequilibrium molecular-dynamics simulation of an inverse twelve soft-sphere liquid undergoing Couette flow. It is shown that the expansion converges slowly if the product tauγ>0.05, where tau is the Maxwell relaxation time and γ is the shear rate. Further, the fourth-rank coefficient that represents cubic symmetry is significant for our model system. The microstructure of a shear liquid is demonstrated by intensity plots of particles around a given central particle. We have derived expressions for the expansion coefficients using a relaxation-time model and the comparison between them and the simulations is generally very good.

6450 High Energy Physics

REFER ALSO TO CITATION(S) 42511

42408 **(CONF-8605182—) Quarks, strings, dark matter, and all the rest.** Panvini, R.S.; Weiler, T.J. (eds.). (Vanderbilt Univ., Nashville, TN (USA)). 1986. Contract FG05-85ER40226. 328p. NTIS, PC A15/MF A01; 1; GPO Dep. File Number DE87012199.

From 7. Vanderbilt high energy physics conference; Nashville, TN, USA (15 May 1986).

Separate abstracts were prepared for 16 papers in these conference proceedings. (LEW)

6451 Particle Interactions And Properties - Experimental

REFER ALSO TO CITATION(S) 41706, 42481, 42489

42409 **(ANL-HEP-CP—87-42) Second class current effects in tau lepton decay?.** Derrick, M. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 11p. (CONF-870283—10). NTIS, PC A02. File Number DE87011542.

From BNL neutrino workshop; Upton, NY, USA (5 Feb 1987).

Experiments to see the effects of second class currents in neutrino interactions are described. Evidence from tau lepton decay is discussed, including the "one-prong anomaly" and direct observation of eta meson production in tau decay. (LEW)

42410 **(ANL-HEP-CP—87-51) New possibilities for exotic hadrons.** Lipkin, H.J. (Argonne National Lab., IL (USA); Weizmann Inst. of Science, Rehovoth (Israel)). 12 May 1987. Contract W-31109-ENG-38. 7p. (CONF-870339—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE87011539.

From Moriond meeting on hadrons, quarks and gluons; Les Arcs, France (15 Mar 1987).

New theoretical ideas and experimental evidence for exotic hadrons are presented. A new exciting candidate is an anticharmed baryon; i.e., a bound state of a nucleon and an F (now called D_s). New experimental evidence for four-quark exotic mesons presented at this conference is discussed. The confusion in the E-iota region and the pseudoscalar spectrum still await further experimental clarification.

42411 **(BNL—39953) πp p → K/sub s/^{0}K/sub s/^{0}n at 22 Gev/c and a systematic study of the 2^{++} and 0^{++} meson spectrum.** Longacre, R.S.; Etkin, A.; Foley, K.J.; Love, W.A.; Morris, T.W.; Platner, E.D.; Saulys, A.C.; Lindenbaum, S.J.; Goo, J.; Kramer, M.A. (Brookhaven National Lab., Upton, NY (USA); City Coll., New York (USA); Brandeis Univ., Waltham, MA (USA); Duke Univ., Durham, NC (USA); Notre Dame Univ., IN (USA)). 23 Jun 1987. Contract AC02-76CH00016. 7p. (CONF-8704177—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012496.

From 2. international conference on hadron spectroscopy; Tsukuba, Japan (16 Apr 1987).

A coupled channel analysis has been carried out using amplitudes of the K/sub s/^{0}K/sub s/^{0} system produced in the reaction π^-p → K/sub s/^{0}K/sub s/^{0}n at 22 Gev/c, which contained about 40,000 events in the low-t region (absolute value of t-tmin < 0.1 Gev^2). The I/sup G/ = 0^+, J/sup PC/ = 0^{++}, 2^{++}, 4^{++} amplitudes from this analysis is considered, together with available data from other experiments in channels with the same quantum numbers in order to determine which 0^{++} and 2^{++} isoscalar mesons have significant pseudoscalar-pseudoscalar couplings. It is found that we need one pole for the 4^{++} amplitudes while the 2^{++} needs five poles and the 0^{++} needs 7 poles.

42412 **(BNL—39954) The Argand amplitudes for the phi phi events from πp p yields phi phi n at 22 GeV/c.** Longacre, R.S.; Etkin, A.; Foley, K.J.; Hackenburg, R.W.; Love, W.A.; Morris, T.W.; Platner, E.D.; Saulys, A.C.; Lindenbaum, S.J.; Chan, C. (Brookhaven National Lab., Upton, NY (USA); City Coll., New York (USA)). 1987. Contract AC02-76CH00016. 5p. (CONF-8704177—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012497.

From 2. international conference on hadron spectroscopy; Tsukuba, Japan (16 Apr 1987).

We obtained the Argand plots for the three phi phi I/sup G/ J/sup PC/ = 0^+2^{++} amplitudes, which completely describe our 6658 events (after a 13% background subtraction) coming from the reaction π^-p → phi phi n at 22 GeV/c. The essential part of this determination is the partial wave analysis of the background reaction π^-p → phi K^+K^-n (1934 events).

42413 **(BNL—39955) Partial wave analysis of K^+ anti K/sub S/π^- final state.** Protopopescu, S.D. (Brookhaven National Lab., Upton, NY (USA)). 19 Jun 1987. Contract AC02-76CH00016. 9p. (CONF-8704177—2). NTIS, PC A02. File Number DE87012495.

From 2. international conference on hadron spectroscopy; Tsukuba, Japan (16 Apr 1987).

A partial wave analysis of high statistics data collected by AGS Experiment No. 771 in reaction π^-p → K^+ anti K/sub S/π^- + n shows evidence for a 1^{++} and a 0^{-+} state in the 1280 MeV region, a 0^{-+} state in the 1420 MeV region and a 1^{++} state in the 1500 MeV region. Preliminary data from reaction K^-p → K^+ anti K/sub S/π^- + X are presented.

42414 **(BNL—39960) Search for neutrino oscillations at BNL preliminary results from E 816 experiment.** Bernardi, G. (Brookhaven National Lab., Upton, NY (USA); Boston Univ., MA (USA); Paris-11 Univ., 91 - Orsay (France). Lab. de Physique Nucleaire et Hautes Energies). Mar 1987. Contract AC02-76CH00016. 12p. (CONF-8703121—4). NTIS, PC A02. File Number DE87012479.

From Telemark IV - neutrino mass and neutrino astrophysics; Ashland, WI, USA (16 Mar 1987).

Neutrino interactions in a fine-grain calorimeter have been analyzed with emphasis on events with associated electromagnetic showers. The good granularity of the detector allows to separate photon from electron showers. The number of events with an electron, according to the present status of our analysis, is found to be about three times larger than expected on the basis of the beam composition. 9 refs., 7 figs.

42415 **(BNL—52079) Proceedings of the BNL neutrino workshop: Opportunities for neutrino physics at BNL.** Murtagh, M.J. (ed.). (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 243p. (CONF-870283—). NTIS, PC A11/MF A01; 1; GPO Dep. File Number DE87012506.

From BNL neutrino workshop; Upton, NY, USA (5 Feb 1987).

Separate abstracts were prepared for twenty papers in these workshop proceedings. (LEW)

42416 **(CERN-HERA—87-01) Compilation of cross-sections. Pt. 4. γ, ν, Λ, Σ, γ, and K/sub L/^{0} induced reactions.** Alekhin, S.I.; Ezhela, V.V.; Lugovsky, S.B.; Tolstenkov, A.N.; Yushchenko, O.P.; Baldini, A.; Cobal, M.; Flaminio, V.; Capiluppi, P.; Giacomelli, G.; HERA Group, COMPAS Group. (European Organization for Nuclear Research, Geneva (Switzerland)). 2 Feb 1987. 124p. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702668.

This is the fourth volume in our series of data compilations on integrated cross-sections for weak, electromagnetic, and strong interaction processes. This volume covers data on reactions induced by photons, neutrinos, hyperons, and K/sub L/^{0}. It contains all data published up to June 1986. Plots of the cross-sections versus incident laboratory momentum are also given.

42417 **(CRN-HE—85-04) Production of the charmonium states in the direct channel of p anti p annihilation and description of a new experimental method. Exclusive reactions p anti p->e/sup +/e/sup -/.** Brom, J.M. (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires). Jun 1985. 166p. (In French). NTIS (US Sales Only), PC A08/MF A01. File Number DE87751824.

The experiment R704 at the CERN Intersecting Storages Rings (ISR) utilised a completely new technique for charmonium spectroscopy, using a cooled antiprotons beam in collision with protons of a dense, molecular H/sub 2/ "jet target". ISR operations, jet target and experimental apparatus are described. Observation of the reaction p anti p->J/PSI->e/sup +/e/sup -/ (193 evts for an integrated luminosity of 141 nb/sup -1/) and estimation of the J/PSI mass using the beam parameters (3098.95 +- 0.1 +- 0.27 Mev) are used to test the method, the energy calibration and the reproductibility of the ISR. From these results, a very good precision of +- 300 KeV is expected in the later results on J/sup PC/ not = 1/sup --/ states. In addition, we give new upper limits for the magnetic form factor of the proton at high transfer.

42418 **(DESY—85-019) Chi/sub b/ states in exclusive radiative decay of the Υ(2S).** Walk, W.; Koenig, A.C.; Metzger, W.J.; Schotanus, J.; Walle, R.T. van de; Antreasyan, D.; Irion, J.; Strauch, K.; Williams, D.; Aschman, D. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.); Katholieke Univ. Nijmegen (Netherlands); Harvard Univ., Cambridge, MA (USA); Cape Town Univ. (South Africa); Princeton Univ., NJ (USA); Stanford Univ., CA (USA). Dept. of Physics). Oct 1985. 36p. (SLAC-PUB—3820). NTIS, PC E07; Available from NTIS as TIB/B87-07331.

The Crystal Ball detector at DORIS II has been used to study radiative decays of the Υ(2S) resonance. We report on the analysis of the exclusive channel Υ(2S) -> γchi/sub b/, chi/sub b/ -> γΥ(1S) -> e/sup +/e/sup -/ or μ/sup +/μ/sup -/. We detect two chi/sub b/ states by observing two monochromatic photon lines at energies (107.0 +- 1.1 +- 1.3) MeV and (131.7 +- 0.9 +- 1.3) MeV respectively. The product branching ratios BR [Υ(2S) -> γchi/sub b/] x BR [chi/sub b/ -> γΥ(1S)] are (1.6 +- 0.3 +- 0.2)% for the first state and (2.1 +- 0.3 +- 0.3)% for the second. For the product branching ratio of the third chi/sub b/ state, which has been observed in inclusive measurements, we find an upper limit of 0.2% (90% C.L.). Combining our results with inclusive measurements, branching ratios for chi/sub b/ -> γΥ(1S) are derived. Using theoretical estimates for the radiative widths of the chi/sub b/ states, we determine their hadronic widths; the results are compared with QCD predictions.

42419 **(DOE/ER/01195—505) Search for nu/sub μ/ → nu/sub e/ oscillations in a narrow band neutrino beam.** O'Brien, E.J. (Illinois Univ., Urbana (USA). Dept. of Physics). 1987. Contract AC02-76ER01195. 154p. (COO—1195-505). NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE87013422.

An experiment that looked for the oscillation nu/sub μ/ → nu/sub e/ was performed using a narrow band nu/sub μ/ beam produced by the AGS at Brookhaven National Lab. Both the nu/sub μ/ and nu/sub e/ reactions in our detector are analyzed. The number of nu/sub e/ events found in the detector is compared to the expected background from Monte Carlo calculations and an excess of 22.4 +- 5.6 +- /sub 3.8//sup 4.4/ events above background is found. The excess represents a 3 standard deviation effect and may suggest a neutrino oscillation. The ratio of the acceptance corrected number of nu/sub e/ and nu/sub μ/ events is calculated from the data. The value is R = (nu/sub e//nu/sub μ/) = 0.0184 +- .0085.

42420 **(DOE/ER/40215—T7) Is there a new pseudoscalar particle?.** Samuel, M.A.; Rajpoot, S. (Oklahoma State Univ., Stillwater (USA). Dept. of Physics). Jun 1987. Contract FG05-85ER40215. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013194.

The decay rate of orthopositronium has recently been measured in a new high precision experiment. The result is 10 standard deviations above the theoretical value. It is shown that a light neutral pseudoscalar R may resolve this discrepancy and still be consistent with the anomalous magnetic moments of the electron and the muon. If the mass m/sub R/ ≦ 5 keV, then the existence of this proposed particle R is consistent with the beam-dump experiments. The lifetime of R is large, tau ≧ .2s.

42421 **(FNAL/C—87/83) Rare B-decays: Experimental prospects and problems.** Bjorken, J.D. (Fermi National Accelerator Lab., Batavia, IL (USA)). May 1987. Contract AC02-76CH03000. 23p. (CONF-870278—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011069.

From 4. family of quarks and leptons international symposium; Santa Monica, CA, USA (26 Feb 1987).

We discuss the future prospects and experimental requirements for generic b-physics, with an emphasis on hadroproduction and on observation of CP violation.

42422 **(IFVE-OEIPK—86-93) Azimuthal correlations between secondary charged hadrons in the K^-p interactions at 32 GeV/c.** Ukhanov, M.N.; Bogolyubskij, M.Yu.; Bumazhnov, V.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 15p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702744.

Investigation results of the azimuthal distribution asymmetry between transverse hadron momenta p/sub T/ in K^-p-interactions at 32 GeV/s are presented. It is shown that the difference in the symmetry for the pion pairs with like and opposite charges is mainly observed at law values of rapidity gaps and is due to the identity effect. With the p/sub T/ growth the difference does not increase, which contradicts the predictions of the Lund quark fragmentational model. Considerable asymmetry has been observed between proton and K/sub S/^{0}-meson which is the evidence of the negative kinematic correlations between p/sub T/ of the leading hadrons. This effect is absent in the Lund model. 22 references, 5 figures, 2 tables.

42423 **(IFVE-ONF—86-133) Inclusive rho^0 meson production in neutrino interactions at the SKAT chamber.** Ammosov, V.V.; Ivanilov, A.A.; Ivanov, P.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702745.

Inclusive rho^0-meson production in the charged current interactions has been studied in the experiment on the SKAT bubble chamber with freon filling exposed to the Serpukhov accelerator neutrino beam. An average multiplicity of the rho^0-meson

0.09+-0.02, the ratio <rho°>/<π^->=0.10+-0.02 have been obtained. The W^2 dependence of the average multiplicity W^2 square of hadron effective mass and differential distributions over variable X/sub F/, Z, P/sub T/^{2} are presented. 19 references, 6 figures, 1 table.

42424 (INIS-mf—10920) Lifetime measurements of charmed mesons with high resolution silicon detectors. Rijk, G.A.F. de. (Amsterdam Univ. (Netherlands)). 20 Nov 1986. 117p. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702787.

In this thesis an experiment is described to measure the lifetimes of pseudoscalar charmed mesons. The experiment uses a negatively charged unseparated hadron beam of 200 GeV. The experiment is carried out with a magnetic spectrometer preceded by a beam telescope, an active target and a vertex telescope, all consisting of Si microstrip detectors. The spectrometer consists of two spectrometer magnets, 48 planes of drift chambers and 3 Cerenkov hodoscopes for the determination and identification of charged sc condaries. The lifetimes of the charmed mesons are determined by measuring the length of their flight path, their momentum and their mass. The results, which are described in the thesis, are based on the analysis of part of the collected data. The production rates in the K^- beam and in the π^- beam are found to be in the same order of magnitude within the x/sub F/ range covered. Previous experimental data on the lifetimes of charmed particles are reviewed. A theoretical interpretation is presented of the measured decay properties. 60 references, 48 figures, 20 tables.

42425 (INIS-mf—10928) Study of the interactions of high energy electron neutrinos. Nieuwenhuis, C.H.M. (Amsterdam Univ. (Netherlands)). 9 Apr 1986. 100p. NTIS (US Sales Only), PC A05/MF A01. File Number DE87702794.

This thesis describes an analysis of electron neutrino and antineutrino interactions with nuclei. The data were collected with the calorimeter of the Amsterdam-CERN-Hamburg-Moscow-Rome (CHARM) group in a beam dump exposure to 400 GeV/c protons from the CERN SPS in 1982. The predictions of the Standard Model for the quantities measured in this experiment are given. The results of the analysis of events without a primary muon in the final state are given in the form of an experimental y-distribution. The measured quantities are compared with the predictions of the theory and the measurements of other experiments. Presented are the cross-section ratio of neutral current and charged current electron neutrino induced events, the prompt CC ν(anti ν)/sub e/ interaction rate, the prompt (ν/sub e/+anti ν/sub e/)/(ν/sub μ/+anti ν/sub μ/) flux ratio, the energy dependence of the prompt electron neutrino flux and a measurement of the DantiD cross-section times semileptonic branching ratio based on prompt electron neutrino interactions. 59 references, 45 figures, 20 tables.

42426 (ITEF—122(1986)) π0 meson forward production in the π^-p -> $\pi^0\pi^+\pi^-\pi^-$p reaction at 4.5 GeV/c. Aleshin, Yu.D.; Vovk, A.I.; Drutskoj, A.G. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1986. 24p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702808.

The mechanism of π^0 meson forward production in the many-particle π^-p->$\pi^0\pi^+\pi^-\pi^-$p reaction at 4.5 GeV/c is considered and resonance eta°(540), ω^0(783) and B^-(1235) states for the given channel of reactions are compared. 3 references, 8 figures.

42427 (ITEF—123(1986)) Study on the B^-(1235) meson production in the π^-p -> B^-p reaction at 4.5GeV/c. Aleshin, Yu.D.; Vovk, A.I.; Drutskoj, A.G. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1986. 15p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702809.

B^- (1225) meson diffraction production was investigated in π^-p -> $\pi^0\pi^-\pi$-π^+p reaction at incident π^- meson momentum 4.5 GeV/c, using two-meter liquid-hydrogen chamber. The channel for studying the diffraction process with π^-p -> B^-p; B^- -> $\omega^0\pi^-$; ω^0 -> $\pi^0\pi^+\pi^-$ intermediate decays was selected by fixed backward proton escape in center-of-mass system cos Θ <- 0.8, where Θ is the angle between π/sub inc/ and p. B^- meson angular characteristics are investigated, polarization moments are determined and the helicity conservation problem is considered. 7 references, 7 figures.

42428 (KFK—4180) Measurement of the electroweak asymmetry of the b-quarks. Knapp, J. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik; Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Physik). Feb 1987. 152p. (In German). NTIS, PC E14; Available from NTIS as TIB/B87-07776.

The prompt electron and muon yield was measured in hadronic events of e/sup +/e/sup -/ annihilation at energies of $\sqrt{s} \approx$ 44 GeV using the CELLO detector at PETRA. A cut in the transverse momentum of the lepton was used to enrich the lepton signals from b-quarks from which the semileptonic branching ratio of the b decay and the electroweak induced charge asymmetry of the banti b production was measured. One finds: Br (b -> e + anti ν/sub e/ + X) = 0.11 +- 0.05 +- 0.05, Br (b -> μ + anti ν/sub μ/ + X) = 0.03 +- 0.04 +- 0.04, A/sub b/(e) =- 0.70 +- 0.52 +- 0.11, A/sub b/(μ) =- 0.55 +- 0.59 +- 0.17. The results are found to be well compatible with the expectation of the standard model.

42429 (LYCEN-TH—8627) Formation of the Chi 1 and Chi 2 charmonium states in p anti p annihilation at the ISR. Fay, J. (Lyon-1 Univ., 69 - Villeurbanne (France). Inst. de Physique Nucleaire). 1986. 164p. (In French). NTIS (US Sales Only), PC A08/MF A01. File Number DE87752274.

R704 experiment has studied the Chi/sub 1/ and Chi/sub 2/ charmonium states (cantic) in their J/Psi Gamma decay. These states are directly formed in the interaction of a hydrogen molecular jet target with a antiprotons beam permanently cooled, circulating in the ring 2 of the ISR. This process allows a high luminosity to be reached (up to 3 10/sup 30/ cm/sup -2/s/sup -1/). The huge hadronic background leads to detect only electromagnetic final states. The detector is a two-arm no magnetic spectrometer in two parts. The first one is devoted to charged particle detection: tracking (MWPC, scintillators) and electron identification (Cerenkov). The second one forms a calorimeter measuring the position and the energy of photons and electrons (lead-scintillator sandwiches, proportional chambers using analogue read-out and lead-glass wall). Event selection is based on Psi identification from two electron tracks (one in each arm) and search for the radiated photon reconstructed from the Chi decay kinematics. For Chi/sub 1/ and Chi/sub 2/ respectively, a set of 32 and 55 events is found with a negligeable background level and one obtains values on mass, width and branching ratios on pantip. These results are compared with theoretical prediction from QCD inspired models: masses are well described by potential methods and sum rules (within a 10 MeV uncertainly). For the widths, only a raw value can be achieved while branching ratios are in good agreement with our measurements.

42430 (MPI-PAE-Exp.El.—172) Semileptonic decays of charmed D/sup +-/ meson: Measurement of the lifetime and the cross-section. Palka, H.; Becker, H.; Belau, E.; Klanner, R.; Luetjens, G.; Lutz, G.; Maenner, W.; Neugebauer, E.; Seebrunner, H.J.; Stierlin, U. (Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (Germany, F.R.). Werner-Heisenberg-Inst. fuer Physik; Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (Germany, F.R.); Science Research Council, Chilton (UK). Rutherford and Appleton Labs.; European Organization for Nuclear Research, Geneva (Switzerland); Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands); Bristol Univ. (UK)). Feb 1987. 19p. NTIS, PC E07; Available from NTIS as TIB/B87-07665.

Using the ACCMOR spectrometer equipped with a vertex telescope of high resolution silicon microstrip detectors 74 decays D/sup +/->anti K/sup *0/(892)e/sup +/0/sub e/ (and cc.) with x/sub F/<0.4 have been observed in 200 GeV π/sup -/Be interactions. The cross-section for D/sup +-/ production, its x/sub F/-dependence in the central region and the D/sup +-/ lifetime have been measured.

42431 **(SLAC-PUB—4328) Preliminary results on B^0-anti B^0 mixing from MAC.** Hurst, R. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). May 1987. Contract AC03-76SF00515. 6p. (CONF-870390—9). NTIS, PC A02/MF A01; GPO Dep. File Number DE87012834.

From 22. Recontres de Moriond: electroweak interactions and unified theories conference; Les Arcs, France (8 Mar 1987).

An excess of like-charge dimuons has been observed with the MAC detector in multihadron events produced in e^+e^- annihilation at $\sqrt{s}$ = 29 GeV. If this excess is attributed to B^0 - anti B^0 mixing, the corresponding value of the mixing parameter chi = $\Gamma(B \rightarrow \mu^- X)/\Gamma(B \rightarrow \mu^{+-} X)$ is chi = 0.21/sub -0.15//sup +0.25/ and chi > 0.02 at 90% C.L.

42432 **(SLAC-PUB—4340) New results from the LASS [Large Aperture Superconducting Solenoid] spectrometer.** Aston, D.; Awaji, N.; Bienz, T.; Bird, F.; D'Amore, J.; Dunwoodie, W.; Endorf, R.; Fujii, K.; Hayashii, H.; Iwata, S. (Stanford Linear Accelerator Center, Menlo Park, CA (USA); Nagoya Univ. (Japan). Dept. of Physics; Cincinnati Univ., OH (USA); Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). 22 Jun 1987. Contract AC03-76SF00515. 8p. (CONF-8704177—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012832.

From 2. international conference on hadron spectroscopy; Tsukuba, Japan (16 Apr 1987).

New results are presented from analyses of several mesonic and baryonic states containing one or more strange quarks. The data are taken from a high statistics (4 events/nb) study of K^-p interactions at 11 GeV/c carried out in the LASS Spectrometer at SLAC. New information is reported on the underlying K^* states and also evidence for selective coupling of K^-eta to the $K^{*\prime}$s; on the strangeonium members of the axial vector nonets in the K anti Kπ channel; and on evidence for an Ω^{*-} state.

42433 **Status of the CDF experiment.** Lockyer, N. (Univ. of Pennsylvania). pp 525-536 of New frontiers in particle physics. Cameron, J.M.; Campbell, B.A.; Kamal, A.N.; Khanna, F.C. Teaneck, NJ; World Scientific Pub. Co. (1986). (CONF-860292—).

From Lake Louise winter institute in particle physics; Edmonton, Alberta, Canada (16 Feb 1986).

A brief review of the status of the Collider Detector Experiment at Fermilab (CDF) is reported. The CDF experiment is an —4μ solid angle multi-purpose detector designed to study proton-antiproton collisions in the 2 TeV center of mass range. This last fall the first few collisions were observed in an engineering rum with a partially assembled detector. The Fall 1986 run will be —3 months in duration with a fully assembled detector.

42434 **Physics results from underground experiments.** Lo Secco, J.M. (Dept. of Physics, Univ. of Notre Dame, Notre Dame, IN 46556). pp 376-392 of New frontiers in particle physics. Cameron, J.M.; Campbell, B.A.; Kamal, A.N.; Khanna, F.C. Teaneck, NJ; World Scientific Pub. Co. (1986). (CONF-860292—).

From Lake Louise winter institute in particle physics; Edmonton, Alberta, Canada (16 Feb 1986).

Physics studied using massive underground detectors is reviewed. Bound proton and neutron decay limits are quoted and compared. The range of interest is now tau — 10/sup 32/ years. Neutron-antineutron oscillations and free proton decay results are examined. Energetic muons arising from atmospheric sources of extraterrestrial sources are examined. The author comments on the current status of energetic muons from Cygnus X3. Energetic muons from atmospheric neutrino interactions are considered. Limits on any excess attributable to celestial point sources are quoted. No sources are currently seen in the data. Intermediate energy neutrino interactions are examined. The observations are consistent with an atmospheric source. Limits are quoted on celestial, stellar and terrestrial sources. Less than 5.5% of the total flux can be attributed to any localized source. Expected geomagnetic modulations are indicated in the neutrino data. The consistency and uniformity of the data have been used to place limits on neutrino oscillations with baselines as long as 10/sup 7/ meters. The future of such experiments and their capabilities is mentioned.

42435 **Future frontiers for e/sup +/e/sup -/ collisions: Physics of SLC and LEP.** Dorfan, J.M. (Stanford Linear Accelerator Center, Stanford Univ., Stanford, CA 94305). pp 82-143 of New frontiers in particle physics. Cameron, J.M.; Campbell, B.A.; Kamal, A.N.; Khanna, F.C. Teaneck, NJ; World Scientific Pub. Co. (1986). (CONF-860292—). Contract AC03-76SF00515.

From Lake Louise winter institute in particle physics; Edmonton, Alberta, Canada (16 Feb 1986).

This paper summarizes three other papers presented in the meeting at the Lake Louise Winter Institute on New Frontiers in Particle Physics. The author reviews the contribution to particle physics of e/sup +/e/sup -/ interactions and the advantages of this laboratory. This followed by a discussion of the LEP and SLC machines and the reasons for developing linear colliders. A brief overview of the Standard Model and some essential formalism for the process e/sup +/e/sup -/ $\rightleftharpoons$ ff-bar are presented, followed by a discussion of detectors. The author also discusses how tests of the Standard Model and physics beyond the Standard Model can be made running at the Z^0. Finally, LEP physics at energies above the Z^0 is discussed.

42436 **Gauginos from pp-bar collisions.** Baer, H.; Hagiwara, K.; Tata, X. (High Energy Physics Div., Argonne National Lab., Argonne, IL 60439). pp 558-566 of New frontiers in particle physics. Cameron, J.M.; Campbell, B.A.; Kamal, A.N.; Khanna, F.C. Teaneck, NJ; World Scientific Pub. Co. (1986). (CONF-860292—).

From Lake Louise winter institute in particle physics; Edmonton, Alberta, Canada (16 Feb 1986).

The author investigate signals for winos (W/sup —/) and winos (Z/sup —/) when the decays W $\rightleftharpoons$W/sup —/γ/sup —/, Z $\rightleftharpoons$W/sup —/Z/sup —/ are allowed at pp-bar colliders. These processes lead to i) monojet and dijet plus missing transverse momentum (p/sub T/) events, ii) various di- and tri-lepton events with little accompanying hadronic activity, and iii) events containing jets plus leptons plus p/sub T/. Absence of such signals may allow new limits to be placed on m/sub —W/ and m/sub —Z/ of at least m/sub —W/ + m/sub —Z/$\geq$ m/sub W/, from CERN collider data.

42437 **Charged particle multiplicities from constituent collisions in very high energy hadronic interactions.** Rudaz, S.; Valin, P. (School of Physics and Astronomy, Univ. of Minnesota, Minneapolis, MN 55455). pp 537-552 of New frontiers in particle physics. Cameron, J.M.; Campbell, B.A.; Kamal, A.N.; Khanna, F.C. Teaneck, NJ; World Scientific Pub. Co. (1986). (CONF-860292—).

From Lake Louise winter institute in particle physics; Edmonton, Alberta, Canada (16 Feb 1986).

The purpose of this paper is to report on a picture of multiparticle production in pp and pp-bar collisions based on elementary subprocesses involving quarks and gluons. The authors state (few) assumptions in due course: the main result of the investigation is to ascribe the violation of KNO scaling observed at the ISR and at the Spp-barS Collider and the rise in the total and inelastic cross-sections for pp and pp-bar collisions to a single effect, namely the onset of gluon-gluon collisions in addition to the basic valence quark collisions which dominate low-energy (up to ISR) processes. The authors reviews the statement of KNO scaling for multiplicity distributions. This was a very important step in correlating energy dependent observables in hadron scattering. Let <n> denote the average charged particle multiplicity, σ/sub n/ the topological cross-section for observing n charged particles in the final state (n is of course even), and σ/sub inel/ the total inelastic cross-section (σ/sub inel/=Σ/sub n/σ/sub n/). The authors derive an analytic form for the KNO scaling function which is in remarkable agreement with data up to ISR energies. In the final section, the authors describe a two-component picture in which the rise of the relative importance of gluon-gluon collisions (with a softer x-distribution for gluons than for quarks) results in the energy dependent violation of KNO scaling observed at colliders.

42438 **The SLC program.** Glashow, S.L. (Stanford Linear Accelerator Center, Stanford Univ., Stanford, CA 94305). pp 781-793 of The 5th topical workshop on proton-antiproton collider physics. Greco, M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-850278—).

From 5. topical workshop on proton-anti-proton collider physics; St. Vincent, Italy (25 Feb 1985).

A brief report on the status of the SLAC Linear Collider program is presented. Progress, current status, and anticipated schedules for machine components and experimental detectors are discussed.

42439 **The search for new effects in e/sup +/e/sup -/ interactions.** Bloom, E.D. (Stanford Linear Accelerator Center, Stanford Univ., Stanford, CA 94305). pp 722-753 of The 5th topical workshop on proton-antiproton collider physics. Greco, M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-850278—).

From 5. topical workshop on proton-anti-proton collider physics; St. Vincent, Italy (25 Feb 1985).

Over the past decade, e/sup +/e/sup -/ colliding beam machines have been a rich source of interesting and frequently exciting new physics. This has been particularly true for the energy range of the J/psi and Y; however, results from the PEP/PETRA machines have also been valuable, e.g., the measurement of the B lifetime. Much effort has been expended in the search for new effects. These include searches for charged and neutral fundamental scalars, new families of quarks, new leptons, lepton-quark substructure, and supersymmetric particles, plus many other topics. In this paper the author discusses a few of these experiments in some detail.

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REFER ALSO TO CITATION(S) 42369, 42410, 42415, 42437, 42494

42440 **(BNL—39947) ELMUD: An ELectron MUon detector for Higgs physics at the SSC.** Paige, F.E. (Brookhaven National Lab., Upton, NY (USA)). Jun 1987. Contract AC02-76CH00016. 8p. (CONF-8705163—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012868.

From From colliders to supercolliders workshop; Madison, WI, USA (11 May 1987).

Requirements for detecting $H \rightarrow Z^0Z^0 \rightarrow l^+l^-l^+l^-$ at the SSC with m/sub H/ = 800GeV are explored. It is found a luminosity of $10^{34}cm^{-2}sec^{-1}$ is needed but that the detector can have only a fast electromagnetic calorimeter plus a muon detector. Such a detector should be feasible at the required luminosity.

42441 **(BNL—39968) QCD Working Group summary.** Bengtsson, H.U.; Gottschalk, T.D.; Paige, F.E. (Brookhaven National Lab., Upton, NY (USA); California Univ., Los Angeles (USA); California Inst. of Tech., Pasadena (USA)). Jun 1987. Contract AC02-76CH00016. 11p. (CONF-8705163—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012486.

From From colliders to supercolliders workshop; Madison, WI, USA (11 May 1987).

The status of Monte Carlo and other perturbative QCD calculations for signals and backgrounds in hadronic collisions is reviewed, and possibilities for improvements are discussed.

42442 **(BONN—87-06) Four-quark states via QCD sum rules.** Reinders, L.J. (Bonn Univ. (Germany, F.R.). Physikalisches Inst.). Apr 1987. 11p. NTIS, PC E07; Available from NTIS as TIB/B87-09394.

We investigate four-quark states via QCD sum rules. In particular, we construct a very reliable sum rule for a strange four-quark resonance which may be identified with the recently discovered particle U(3.1).

42443 **(CBPF-MO—001/86) Models in elementary particle physics.** Majerotto, W. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). Oct 1985. 92p. NTIS (US Sales Only), PC A05/MF A01. File Number DE87702661.

A review or Elementary Particle models is made giving emphais in the experimental aspects which support them.

42444 **(CEA-CONF—8341) Production of supersymmetric pairs at anti pp colliders.** Peschanski, R. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Inst. de Recherche Fondamentale (IRF)). Feb 1985. 28p. (CEA-SPhT—86-003; CONF-8501109—1). NTIS (US Sales Only), PC A03/MF A01. File Number DE87752260.

From 3. CSIC workshop on SUSY and grand unification from strings to collider phenomenology; Madrid, Spain (30 Jan 1985).

Production and decay rates of squarks and gluinos at anti pp colliders are shown to depend not only on the mass scale but on the ratio of squark to gluino mass. In the degenerate case which is shown to be natural in a large class of broken Supergravity models with minimal field content the predicted cross-sections are enhanced by a sizeable factor. This gives an improved bound on the squark mass (70 GeV) from the analysis of Cern monojets and indications for the search of squark decay modes of supersymmetric pairs at antipp colliders in the near future.

42445 **(CRN-PN—86-02) Chiral symmetry breaking and the pion quark structure.** Bernard, V. (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires). 1986. 172p. (In French). NTIS (US Sales Only), PC A08/MF A01. File Number DE87752281.

The mechanism of dynamical breaking of chiral symmetry in hadronic matter is first studied in the framework of the Nambu and Jona-Lasinio model on one hand and its generalisation to finite hadron size on the other hand. The analysis uses a variational procedure modelled after the BCS superconductor. Our study indicates for example, a great sensitivity of various quantities characterizing the breaking of symmetry to the shape of the interaction. Also the mechanism of breaking of chiral symmetry is essentially related to the mechanism of confinement. When a symmetry is spontaneously broken, there exists a Goldstone particle of zero mass. This is true in our model. This particle, the pion, is obtained as solution of a Bethe Salpeter equation for a qantiq bound state. This enables us to establish a connection between the pion as a Goldstone boson related to spontaneous symmetry breaking and the quark-antiquark structure of the pion. The finite mass of the physical pion is obtained with non zero current quark mass. Various properties of this particle are then studied in the RPA formalism. One important point of our model is the highly collective character of the pion. 85 refs.

42446 **(DOE/ER/40150—4) Current conservation and interaction currents in relativistic meson theories.** Gross, F.; Riska, D.O. (College of William and Mary, Williamsburg, VA (USA). Dept. of Physics; Helsinki Univ. (Finland). Dept. of Physics; Continuous Electron Beam Accelerator Facility, Newport News, VA (USA)). 1985. Contract AC05-84ER40150. 48p. (CEBAF-PR—87-022). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87012469.

The relation between the nucleon-nucleon interaction and exchange currents needed for current conservation are derived for the Bethe-Salpeter formalism, and for the approach in which the spectator particle is restricted to its mass shell. For both approaches, it is shown how to achieve current conservation for a completely general isospin dependent, energy dependent interaction with arbitrary phenomenological electromagnetic form factors for the nucleon and mesons, and with strong form factors at the meson-nucleon vertices. Contrary to what has often been stated in the literature, the development shows that current conservation places no restrictions on the use of different electromagnetic form factors for mesons and nucleons, and that phenomenological meson-nucleon form factors can be introduced in a way which is consistent with current conversation. The longitudinal part of the exchange current is uniquely determined by current conservation, and for the common case of an interaction that only depends on the invariant momentum transfer variable an explicit expression for this longitudinal exchange current is given. The transverse part, which contains all electromagnetic form factors, is unconstrained by current conservation.

42447 **(EFI—829(56)-85) Total cross sections and slopes at superhigh energies.** Eremyan, Sh.S.; Zhamkochyan, V.M. (Erevanskij Fizicheskij Inst. (USSR)). 1985. 38p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87702680.

A comparative analysis of hadron-hadron interactions in theories with critical and supercritical pomerons is carried out. The main characteristics of binary interactions in both theories are shown practically to coincide to each other in the whole range of accessible energies. Also an analysis of characteristics of hadron-nuclei interactions is given in the framework of Reggeon field theory with critical and supercritical pomerons and multiple scattering theory. The results obtained agree with available experimental data on proton-nuclei interactions at superhigh energies.

42448 **(EFI—830(57)-85) Electric dipole photoabsorption and quark structure of nucleons.** Aznauryan, I.G.; Davtyan, L.S.; Margaryan, A.T.; Matinyan, S.G. (Erevanskij Fizicheskij Inst. (USSR)). 1985. 16p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702681.

The sum rules for electric dipole photoabsorption are considered in the framework of constituent quark model. Experimental data on electric dipole photoabsorption on a proton up to the photon energy of 1.2 GeV are well described by sum rules of zero and first negative moments. The first sum rule predicts equality of contributions into integrals for photoabsorption on proton and neutron, this making important to obtain qualitative photoabsorption data on neutron. The second rule indicates that in nucleon there is large admixture of [70.0$^+$] multiplet, the latter being necessary also from the viewpoint of mass formulae for baryons. 14 references, 1 figure, 2 tables.

42449 **(EFI—834(61)-85) Higgs boson production in hadronic decays of c-even quarkonia.** Alanakyan, R.A.; Grigoryan, S.G.; Matinyan, S.G. (Erevanskij Fizicheskij Inst. (USSR)). 1985. 40p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87702685.

The differential characteristics and total widths for H^0-boson production in hadronic decays of C-even heavy quarkonia (eta, chi_0, chi_1, chi_2) are studied. A comparison of differential distributions and total widths for scalar and pseudoscalar boson production in eta-quarkonium decays is carried out. The dependences of the studied characteristics on the mass of heavy quark and Higgs boson are investigated.

42450 **(EFI—835(62)-85) Theoretical predictions for some characteristics of exotic baryon production in hadron processes.** Grigoryan, A.A.; Khachatryan, G.N. (Erevanskij Fizicheskij Inst. (USSR)). 1985. 34p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87702686.

The properties of exotic baryon resonances whose existence is predicted from the sum rules for the reggeon-particle scattering amplitudes are given. The theoretical calculations of the cross sections of these resonance production in the processes on π and Σ beams as well as of the angular distributions of their decay products are carried out.

42451 **(EFI—840(67)-85) Model for decays of boson resonances with arbitrary spins.** Grigoryan, A.A.; Ivanov, N.Ya. (Erevanskij Fizicheskij Inst. (USSR)). 1985. 24p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702691.

A formula for the width of resonance with spin J decay into hadrons with arbitrary spins is derived. This width is expressed via S-channel helicity residues of Regge trajectory α/sub J/ where the resonance J lies. Using the quark-gluon picture predictions for the coupling of quarks with Regge trajectories and SU(6)-classification of hadrons this formula is applied to calculate the widths of decays of resonances, which lie on the vector and tensor trajectories, into pseudoscalar and vector, two vectors and NN-bar-pair.

42452 **(EFI—843(70)-85) Inclusive spectra of hadrons in collisions of π -and k mesons with nuclei.** Gevorkyan, S.R.; Gulkanyan, G.R.; Kotsinyan, Ar.M.; Zhamkochyan, V.M. (Erevanskij Fizicheskij Inst. (USSR)). 1985. 16p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702694.

Calculations within model of multiple scattering for the processes of inclusive hadron production on nuclei under the action of meson teams (π and K) are carried out. The calculations are in satisfactory agreement with experimental data available at high energies.

42453 **(EFI—844(71)-85) EMC-effect and QCD evolution of the threequark nucleon picture.** Grigoryan, L.A.; Shakhbazyan, V.A. (Erevanskij Fizicheskij Inst. (USSR)). 1985. 18p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702695.

It is shown that the EMC-effect can be explained in the framework of the QCD evolution of the threequark nucleon picture. In comparing with the experimental data it is found that the effective radius of nucleon, which is in the iron nucleus, increases by 10% as compared with the free nucleon case. A comparison with experimental data in the region of $0.25 \leqq x \leqq 0.65$ is made.

42454 **(EFI—850(1)-86) Standard Higgs boson distribution over q/sub perpendicular/ born in hadron-hadron collisions.** Egoryan, R.Sh. (Erevanskij Fizicheskij Inst. (USSR)). 1986. 26p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87702699.

The spectrum of standard Higgs H_0 boson over transverse moment q/sub perpendicular/ in different, qq-bar; gq(q-bar); gg, channels of production at hadron-hadron collisions is studied. The existence of a qualitative difference between the spectra $d\sigma$/dq/sub perpendicular/^{2} of H_0 boson and of chi/sub QQ-bar//sup (0)/ (Q=b, t...)-meson, for instance, in a quark channel, is shown. It permits to unambiguously identify H_0 by $d\sigma$/dq/sub perpendicular/^{2} spectrum in the full range of masses M/sub H/ >or approx. 10 GeV. The influence of the highest orders of perturbation theory on $d\sigma$/dq/sub tr/^{2} spectra of H_0 bosons is also discussed.

42455 **(EFI—851(2)-86) Description of correlations of charged and neutral particles in multiple hadron-hadron processes.** Torosyan, G.T. (Erevanskij Fizicheskij Inst. (USSR)). 1986. 16p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702700.

A comparison of model predictions with the experimental data on correlations of charged and neutral particles in hadron-hadron processes at high energies is carried out in the framework of the model of two mechanisms of multiple production. Predictions on multiple characteristics of final neutral particles in K^+p and π^+p reactions at P=250 GeV/c are presented. Experimental data on these reactions will be obtained on European Hybrid Spectrometer (EHS) in the nearest future.

42456 **(EFI—854(5)-86) Inclusive specta of hadronic resonances in the framework of multiparton recombination model. 1. Proton fragmentation.** Badalyan, R.G.; Gulkanyan, G.R.; Korchagin, S.A. (Erevanskij Fizicheskij Inst. (USSR)). 1986. 18p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702701.

Spectra of direct fragmentation of proton into baryonic and mesonic resonances with small transverse momenta are obtained in te framework of multiparton recombination model. Calculations satisfactorily describe the available experimental data on the x-dependence of inclusive spectra of baryonic $\Delta^{++}(1232)$, $\Sigma^{+-}(1385)$ and mesonic rho^0, $K^+(1430)$, $K^+(890)$ resonances in a wide (over x) range of proton fragmentation in pp, $K^{+-}p$ and $\pi^{+-}p$ interactions at high energies.

42457 **(EFI—855(6)-86) Peculiarities of the quark channels of standart Higgs boson production in hadron-hadron collisions.** Egoryan, R.Sh. (Erevanskij Fizicheskij Inst. (USSR)). 1986. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702702.

The quark channel of Higgs boson production at hadron-hadron collisions is discussed. It is shown that H_0-boson spectrum in this channel qualitatively differs from the spectra of chi-meson. Such difference in spectra which is due to non-relativistic character of chi-mesons may reveal a unique possibility of H_0-boson identification by spectrum in the whole range of masses of chi-mesons.

42458 (IFT-P—05/86) Pion mass splitting in the standard model. Natale, A.A. (Instituto de Fisica Teorica, Sao Paulo (Brazil)). 1986. 5p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702739.

The mass difference of pions is studied in the standard model, paying particular attention to the short distance QCD contribution, which has been handled following the prescription of Brodsky, de Teramond and Schmidt, leading to a calculable result.

42459 (IFT-P—06/86) Centre-of-mass corrections for the harmonic S+V potential model. Palladino, B.E.; Ferreira, P.L. (Instituto de Fisica Teorica, Sao Paulo (Brazil)). 1986. 12p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702740.

Center-of-Mass corrections to the mass spectrum and static properties of low-lying S-wave baryoins are discussed in the context of a relativistic, independent quark model, based on a Dirac equation, with equally mixed scalar and vector confining potential of harmomic type. A more stisfactory fitting of the parameters involved is obtained, as compared with previous treatments which CM corrections were neglected.

42460 (IFVE-OTF—86-79) Binary processes at high energies: regularities of behaviour. Troshin, S.M.; Tyurin, N.E. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 7p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702748.

Dynamical properties of a+b -> c+d inelastic binary reaction have been considered. Universal regularities which should obey the behaviour of angular distributions and polarization parameter in these reactions at $-t \geqq 1$ (GeV/c)^2 have been found. These regularities are a dynamical manifestation of the effects connected with unitarity of the scattering matrix. Comparison with experimental data has been made. 7 references, 2 figures.

42461 (IFVE-OTF—86-151) Dilaton as an analogue of Higgs boson in composite models. Jikia, G.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 12p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702750.

It is shown that in the models with composite quarks, leptons and W-, Z-bosons there should exist a scalar particle - dilaton, whose interaction almost completely coincides with Higgs boson interaction in the standard model. Effective Lagrangians for dilaton interaction have been obtained. Dilaton production and decay process have been analyzed. Possibilities to distinguish dilaton from standard Higgs boson in experiment are indicated. 28 references, 1 figure.

42462 (IFVE-OTF—86-166) Hadronic production of mixed flavour heavy particles. Kiselev, V.V.; Likhoded, A.K.; Tkabladze, A.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 6p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702751.

Calculations of the pair-production for charmed-beauty mesons at $\sqrt{s} \simeq 100$ GeV have been carried out in the framework of QCD and parton model. 2 references, 2 figures.

42463 (IFVE-OTF—86-170) Necessary to measure total cross sections. Petrov, V.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 16p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702752.

A mini-review of the turned out to present time situation in the theory of diffractive hadron interactions at high energies is undertaken. 13 references, 8 figures.

42464 (INIS-mf—10921) Kinetic theory of quantum systems. Calkoen, C.J. (Amsterdam Univ. (Netherlands)). 1 Oct 1986. 105p. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702788.

The contents of this thesis which deals with transport phenomena of specific gases, plasmas and fluids, can be separated into two distinct parts. In the first part a statistical way is suggested to estimate the neutrino mass. Herefore use is made of the fact that massive neutrinos possess a non-zero volume viscosity in contrast with massless neutrinos. The second part deals with kinetic theory of strongly condensed quantum systems of which examples in nature are: liquid Helium, heavy nuclei, electrons in a metal and the interior of stars. In degenerate systems fermions in general interact strongly so that ordinary kinetic theory is not directly applicable. For such cases Landau-Fermi-liquid theory, in which the strongly interacting particles are replaced by much weaker interacting quasiparticles, proved to be very useful. A method is developed in this theory to calculate transport coefficients. Applications of this method on liquid ^{3}Helium yield surprisingly good agreement with experimental results for thermal conductivities.

42465 (INS—587) Pion reabsorption effect on pion spectra in high energy heavy ion collisions. Kitazoe, Y.; Sano, M.; Toki, H.; Nagamiya, S. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). May 1986. 14p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702603.

The cascade model calculations are extended to study the pion energy spectra in high energy heavy ion collisions of heavy systems. It is found that pion reabsorption ($\pi + N \rightarrow \Delta$) is essential in explaining the difference between the energy slopes for pions and protons. This pion reabsorption effect becomes more and more important as the mass number increases and reproduces even the observed fall-off of the energy slopes (temperatures) for pions in the collisions of heavier nuclei. The authors calculate also the average pion multiplicities of positive and negative pions as a function of mass number, which are shown to be affected drastically by the pion absorption process ($\Delta + N \rightarrow N + N$) in heavier nuclei.

42466 (ITEP—127(1986)) Dibaryon resonances as rotational excitations of six-quark states. Kondratyuk, L.A.; Martem'yanov, B.V.; Shchepkin, M.G. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1986. 24p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702811.

Using the model of streched rotating (stringlike) bags with spin-orbit interaction of quarks the properties of nonstrange dibaryon spectrum are considered. The resonance d'(T=0, J/sup P/ =2$^-$) near the πNN threshold with the mass 1.95+2.05 GeV is predicted. Two other members of this family in spin-orbit are also predicted: d''(1$^-$) and d'''(0$^-$) (δE/sub ls/=30-40 MeV). Possible exostence of narrow dibaryon states with isospin T=1 and 2 is doscussed. 25 references, 2 tables.

42467 (ITEP—128(1986)) Narrow dibaryon resonances. Kajdalov, A.B. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1986. 12p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702812.

Experimental data on np interactions indicating to existence of narrow resonances in pp-system are discussed. Possible theoretical interpretations of these resonances are given. Experimental characteristics of the dibaryon resonances with isospin I=2 are considered. 11 references, 7 figures.

42468 (ITEP—131(1986)) S-wave πN resonances and cryptoexotic q^4q^- states. Grach, I.L.; Kalashnikova, Yu.S.; Narodetskij, I.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1986. 16p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702813.

The Quark Compound Bag (QCB) model is successfully applied to the description of S-wave π N amplitudes at low energy. The calculated parameters of πN QCB interactions are found to be in good agreement with theoretical predictions for MIT bag model. The masses and widths of the πN resonances are given. 10 references, 3 figures.

42469 **(ITEP—134(1986)) Description of nucleon and pion form factors in quantum chromodynamics.** Gorskij, A.S.; Terent'ev, M.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1986. 12p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702608.

For pion and nucleon electromagnetic form factors a unified picture of the sequence of theoretical regimes in the whole variation range of momentum transfer squared is described in a concise and tractable form. The picture is in agreement with the available experimental data and provides with certain qualitative predictions in the domain where the data are absent now. 32 references, 5 figures.

42470 (JINR—D-10-11-84-818, pp 201-203) **Regularization method for solving the inverse scattering problem.** Denisov, A.M.; Krylov, A.S. (Moskovskij Gosudarstvennyj Univ., USSR). 1985. (In Russian). NTIS (US Sales Only), PC A16/MF A01. File Number DE87780164. (CONF-8309402—).

From 5. international meeting on problems of mathematical simulation, programming, and mathematical methods for solving the physical problems; Dubna, USSR (20 Sep 1983).

The inverse scattering problem for the Schroedinger radial equation consisting in determining the potential according to the scattering phase is considered. The problem of potential restoration according to the phase specified with fixed error in a finite range is solved by the regularization method based on minimization of the Tikhonov's smoothing functional. The regularization method is used for solving the problem of neutron-proton potential restoration according to the scattering phases. The determined potentials are given in the table. 5 refs.

42471 (JINR—D-10-11-84-818, pp 232-234) **Effective iterative method of inversion of the fermionic matrix in lattice quantum chromodynamics.** Bogolyubskij, I.L.; Bogolyubskaya, A.A. 1985. (In Russian). NTIS (US Sales Only), PC A16/MF A01. File Number DE87780164. (CONF-8309402—).

From 5. international meeting on problems of mathematical simulation, programming, and mathematical methods for solving the physical problems; Dubna, USSR (20 Sep 1983).

A new iterative method for inversion of the fermionic matrix in lattice quantum chromodynamics is proposed. The more effective version of the conjugate gradient method forms the basis of the method. The new method permits to calculate, for instance, masses of the ground states of mesons and baryons in rather large lattices. 6 refs.

42472 **(JINR-E—2-86-260) Radiative corrections to neutrino deep inelastic scattering.** Bardin, D.Yu.; Dokuchaeva, V.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1986. 15p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702823.

A unique set of formulae is presented for the radiative corrections to the double differential cross section of deep inelastic neutrino scattering in channels of charged and neutral currents within a simple quark parton model in a renormalization scheme on mass-shell. It is shown that these cross sections when being integrated up to the one-dimensional distribution or up to the total cross section reproduce many results existing in the literature. 23 references, 1 figure, 1 table.

42473 **(JINR-E—2-86-466) Pair creation effect in radiative bottonium transitions.** Lewin, K.; Motz, G.B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1986. 10p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702824.

The contributions from internal b-quark pair creation to the radiative transition rates of the processes Y(2S) -> X/sub b/^{1}+γ and X/sub b/^{2} -> Y(1S)+γ have been estimated in a quasilocal approximation preserving the time-dependence of the antiquark propagator and found to be smaller than 10%. Although relatively small, the pair creation correction depends sensitively on quark masses and photon energies and thus cannot be ignored in quantitative investigations of radiative quarkonium transitions. 8 references, 6 figures.

42474 **(LA-UR—87-2096) Heavy multiquark states.** Heller, L. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 14p. (CONF-8703136—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011762.

From Elementary structure of materials; Les Houches, France (24 Mar 1987).

From minimal assumptions that are consistent with Quantum Chromodynamics, it is shown that for sufficiently large mass the dimeson must be bound. A method for deriving the static part of the potential energy is discussed, and the method for solving the four-body problem and the results are presented. (LEW)

42475 **(LBL—22404) Collider physics for the late 1980's.** Hinchliffe, I. (Lawrence Berkeley Lab., CA (USA)). 27 Feb 1987. Contract AC03-76SF00098. 90p. (CONF-8606259—7). NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87007608.

From Theoretical Advanced Study Institute conference; Santa Cruz, CA, USA (23 Jun 1986).

Topics in the Standard Model of strong and electroweak interactions and how these topics are relevant for the high energy colliders are discussed. Radiative corrections in the Glashow-Weinberg-Salam model are discussed, stressing how these corrections may be measured at LEP and the SLC. CP violation is discussed, followed by a discussion of the Higgs boson and the searches which can be carried out for it. Some features of quantum chromodynamics are discussed which are relevant to hadron colliders. Some of the problems which the Standard Model does not solve are discussed. 115 refs., 53 figs. (LEW)

42476 **(SLAC-PUB—4150) Hadron cascades produced by electromagnetic cascades.** Nelson, W.R.; Jenkins, T.M.; Ranft, J. (Stanford Linear Accelerator Center, Menlo Park, CA (USA); Karl-Marx-Universitaet, Leipzig (German Democratic Republic). Sektion Physik). Dec 1986. Contract AC03-76SF00515. 6p. (CONF-870219—11). NTIS, PC A02. File Number DE87010320.

From 20. midyear topical symposium of the Health Physics Society: health physics of radiation-producing machines; Reno, NV, USA (8 Feb 1987).

A method for calculating high energy hadron cascades induced by multi-GeV electron and photon beams is described. Using the EGS4 computer program, high energy photons in the EM shower are allowed to interact hadronically according to the vector meson dominance (VMD) model, facilitated by a Monte Carlo version of the dual multistring fragmentation model which is used in the hadron cascade code FLUKA. The results of this calculation compare very favorably with experimental data on hadron production in photon-proton collisions and on the hadron production by electron beams on targets (i.e., yields in secondary particle beam lines). Electron beam induced hadron star density contours are also presented and are compared with those produced by proton beams. This FLUKA-EGS4 coupling technique could find use in the design of secondary beams, in the determination high energy hadron source terms for shielding purposes, and in the estimation of induced radioactivity in targets, collimators and beam dumps.

42477 **(SLAC-PUB—4327) Generation mixing and CP-violation, standard and beyond.** Harari, H. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). May 1987. Contract AC03-76SF00515. 18p. (CONF-870334—2). NTIS, PC A02. File Number DE87011595.

From Workshop on results and perspectives in particle physics; La Thuile, Italy (1 Mar 1987).

We discuss several issues related to the observed generation pattern of quarks and leptons. Among the main topics: Masses, angles and phases and possible relations among them, a possible fourth generation of quarks and leptons, new bounds on neutrino masses, comments on the recently observed mixing in the B - anti B system, CP-violation, and recent proposals for a b-quark "factory".

42478 Systematic examination of spin-independent and spin-dependent interactions of heavy quarks. Olsson, M.G.; Suchyta III, C.J. (Physics Department, University of Wisconsin, Madison, Wisconsin 53706). *Physical Review [Section] D: Particles and Fields;* **36**: No. 5, 1459-1464(1 Sep 1987).

There is now convincing evidence that the spin dependence of quarkonia systems requires an effective scalar confining potential. We show that all known cc-bar and bb-bar spin dependences are consistent with a vector-scalar model. We find, however, that the spin-averaged states are inconsistent with spin-independent corrections arising from a scalar potential. A more successful confining interaction is obtained by using a phenomenological spin-independent term introducing flavor dependence into the potential by means of inverse powers of the quark masses.

42479 Strongly coupled quarks in the standard model. Johnson, R.; Schechter, J. (Physics Department, Syracuse University, Syracuse, New York 13244-1130). *Physical Review [Section] D: Particles and Fields;* **36**: No. 5, 1484-1489(1 Sep 1987).

For sufficiently strong Yukawa couplings the standard model goes over to the linear σ model. We point out that the associated heavy quarks may behave like strongly interacting low-energy u and d quarks so one cannot argue that very-heavy-quark systems will provide an easy test of QCD. An upper-quark-mass bound of about 1.5 TeV is found. (This should also apply to techni-quarks.) Experimental confirmation of the scheme might come from the observation of very tightly bound baryons made from three heavy quarks.

42480 Second-class currents or symmetry breaking in tau decay. Berger, E.L.; Lipkin, H.J. (Argonne National Lab., IL; Weizmann Institute of Science, Rehovoth, Israel). *Physics Letters [Section] B;* **189**: No. 1/2, 226-231(30 Apr 1987). Contract W-31-109-ENG-38.

Recent reports of a possible decay tau -> ν/sub tau/ +eta+π suggest either isospin symmetry breaking or the presence of a second class current. The transition W -> scalar meson is considered and shown by simple arguments to be suppressed in any model where the W decays into a quark-antiquark pair with a pointlike coupling and the hadronization of the pair occurs subsequently. The suppression in the amplitude occurs already at the stage of the pointlike coupling and is proportional to the u-d mass difference. Isospin symmetry breaking in the hadronization process cannot affect the transition.

42481 Monojets and supersymmetry. Kane, G. (Randall Lab. of Physics, Univ. of Michigan, Ann Arbor, MI 48109-1120). pp 387-395 of The 5th topical workshop on proton-antiproton collider physics. Greco, M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-850278—).

From 5. topical workshop on proton-anti-proton collider physics; St. Vincent, Italy (25 Feb 1985).

If collider events with large missing momentum are found to occur, it has been known for several years that they could be due to the production of supersymmetric partners of quarks and gauge bosons. The author reports here on a general, systematic analysis, as to whether a quantitative description of reported (preliminary) data could be given in terms of such a highly constrained theory as supersymmetry. The author finds that the answer is yes, for one or two very limited regions of superpartner masses. In addition, he argues that present data probably does not rule out light gluinos.

42482 Heavy Higgs production and detection. Gordon, H.A.; Marciano, W.; Paige, F.E.; Grandis, P.; Naculich, S.; Williams, H.H. (Brookhaven National Lab., Upton, NY 11973). pp 161-164 of Proceedings of the 1982 DPF summer study on elementary particle physics and future facilities. Donaldson, R.; Gustafson, R.; Paige, F. Washington, DC; National Science Foundation (1982). (CONF-8206116—).

From DPF summer study on elementary particle physics and future facilities (APS); Aspen, CO, USA (28 Jun 1982).

The authors have studied the production rate for very heavy Higgs scalars at high luminosity hadron-hadron colliders via the gluon fusion mechanisms. For a Higgs mass m/sub H/ > 2m/sub Z/, the decay modes $H^0 \rightarrow W^+ W^-$ or $Z^0 Z^0$ dominate. Requiring that one W or Z decay into leptons may provide a detectable signal above background. The standard SU(2)/sub L/ x U(1) model requires the existence of a neutral spin zero particle, H^0, called the Higgs scalar. It is a remnant of the spontaneous symmetry breaking mechanism which provides mass for the W/sup +-/ and Z^0 as well as quarks and charged leptons. Detection of this fundamental scalar is crucial, if one is to confirm the standard model. Unfortunately, the H^0's mass, m/sub H/, is essentially a free parameter; however, theory provides some guidance. Vacuum stability requires m/sub H/ > 7 GeV while perturbative unitarity suggests m/sub H/ < 1 TeV. Together, these constraints imply: 7 GeV < m/sub H/ 1 TeV. Arguments for a more restricted range are less compelling.

6453 Particle Invariance Principles And Symmetries

REFER ALSO TO CITATION(S) 42444, 42481, 42508

42483 (IC—86/170) Coset spaces as alternatives to Calabi-Yau spaces in the presence of Gaugino condensation. Govindarajan, T.R.; Joshipura, A.S.; Rindani, S.D.; Sarkar, U. (International Centre for Theoretical Physics, Trieste (Italy)). Dec 1986. 46p. NTIS (US Sales Only), PC A03/ MF A01. File Number DE87702570.

Compactification of the field-theory limit of the $E_8 \times E'_8$ heterotic string on six-dimensional coset manifolds is discussed, with specific reference to maintaining four-dimensional supersymmetry. By choosing a torsion proportional to the background value of the three-index field H/sub mnp/ occurring in the theory it is possible to satisfy the condition of SU(3) holonbmy necessary for supersymmetry. However, in all cases considered, it is found impossible to satisfy all the remaining conditions for supersymmetry. If gaugino condensation is assumed to occur, it is possible to preserve supersymmetry satisfying all the modified requirements of supersymmetry for the spaces SU(3)/U(1)xU(1), G_2/SU(3) and SO(5)/ SU(2)xU(1). The question of chiral fermions is examined in these cases using the Atiyah-Singer index theorem. Background gauge fields, which correspond to different numbers of generations of chiral fermions, are constructed explicitly. In all these cases the low-energy symmetry group is $E_8 \times E'_8$. 26 references.

42484 (IC—86/243) Supersymmetric quantum mechanics of the relativistic particle. Gamboa, J.; Zanelli, J. (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1986. 10p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702576.

An alternative formulation for the superparticle in a scalar potential is presented. This method is based on a combination between the ground state wave function representation and supersymmetric quantum mechanics. For the free relativistic particle case, differences are found and discussed. 14 references.

42485 (IC—86/258) N=2 supersymmetric Ward-identities on harmonic superspace. Lhallabi, T. (International Centre for Theoretical Physics, Trieste (Italy)). Sep 1986. 23p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702578.

The quantization of N=2 supersymmetric Yang-Mills theory coupled to matter hypermultiplet has been done in the harmonic superspace, by requiring BRS and anti-BRS invariance. Also the corresponding Ward-identities have been derived. 13 references.

42486 (IC—86/286) Supertwistors and superfields. Kotrla, M.; Niederle, J. (International Centre for Theoretical Physics, Trieste (Italy)). Sep 1986. 17p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702589.

In this paper, the contour integral transforms are presented which generate superfields with arbitrary conformal weights and on all superspaces considered in a previous paper by this author. 9 references.

42487 **BRST and Osp(2vertical stroke2).** Aratyn, H.; Ingermanson, R.; Niemi, A.J. (Ohio State Univ., Columbus; California Univ., Berkeley; Lawrence Berkeley Lab., CA). *Physics Letters [Section] B;* **189**: No. 4, 427-430(14 May 1987). Contract AC02-76ER01545;AC03-76SF00098.

A canonical system with first-class constraints admits a Parisi-Sourlas type Osp(2vertical stroke2) invariance for each of its constraints and the standard BRST and anti-BRST operators are generators in a direct sum representation of the Osp(2vertical stroke2) Lie algebra. This direct sum representation has two additional nilpotent anticommuting generators which are on an equal footing with the standard BRST operators, and any one of these four operators could be used as the BRST operator of the theory.

42488 **A peek into the shadow world.** Kolb, E.W.; Seckel, D.; Turner, M.S. (Fermilab Astrophysics Center, Fermi National Accelerator Lab., Batavia, IL 60510). pp 111-118 of New trends in particle theory. Lusanna, L. Teaneck, NJ; World Scientific Pub. Co. (1985).

At present, the most promising superstring theory has the guage symmetry E/sub 8/ x E/sub 8/,. If one of the E/sub 8/'s describes all the known particles and forces, matter in the other E/sub 8/ (shadow matter) would interact with ordinary matter only through gravitational-strength interactions. Reviewed here are the cosmological and astrophysical implications of shadow matter.

6454 Field Theory

REFER ALSO TO CITATION(S) 42336, 42441, 42471, 42479, 42488, 42609, 42620

42489 **(ANL-PHY—87-2) Quarks, QCD [quantum chromodynamics] and the real world of experimental data.** Lipkin, H.J. (Argonne National Lab., IL (USA)). Jul 1987. Contract W-31109-ENG-38. 63p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87011651.

The experimental evidence that supports quantum chromodynamics as the theory that describes how the quarks interact is briefly discussed. The indications of the existence of quarks are reviewed, and calculation of hadron masses is discussed. Additional evidence of hadron substructure as seen in the antiproton is reviewed. Arguments for the existence of color as the "charge" carried by quarks by which they interact are given. Hadron masses and the hyperfine interaction are presented, followed by more exotic quark systems and a study of multiquark systems. Weak interactions in the quark model are discussed. (LEW)

42490 **(CBPF-NF—007/86) Effective theory of massive gauge bosons.** Doria, R.M.; Helayel Neto, J.A. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1986. 22p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702665.

The coupling of a group-valued massive scalar field to a gauge field through a symmetric rank-2 field strenght is studied. By considering energies very small compared with the mass of the scalar and invoking the decoupling theorem, one is left with a low-energy effective theory describing a dynamics of massive vector fields.

42491 **(CBPF-NF—018/86) Construction of the U-matrix from Dirac Brackets in Q.C.D. .** Santos, M.A. dos; Mello, J.C.; Simao, F.R.A. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1986. 7p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702666.

The U-matrix is formally obtained in Q.C.D. from Dirac brackets.

42492 **(CEA-CONF—8315) Relaxation and correlations in time in a finite volume.** Zinn-Justin, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Inst. de Recherche Fondamentale (IRF)). Nov 1985. 7p. (SPhT—85-007; CONF-8511170—3). NTIS (US Sales Only), PC A02/MF A01. File Number DE87751805.

From Lattice gauge theory: a challenge in large scale computing conference; Wuppertal, F.R. Germany (5 Nov 1985).

To describe relaxation towards equilibrium and correlating in time in stochastic numerical simulations, it is necessary to examine dynamical stochastic evolution equations from the renormalization group (R.G.) point of view, an then finite volume effects since all numerical simulations take place of course in a finite volume. The stochastic evolution equation which describes in the continuum space and time limit the time behavior of numerical simulations is the Langevin equation and in a first part we discuss briefly its algebraic properties. We show how it is possible to associate with the Langevin equation a conventional effective action in such a way that its renormalization and R.G. properties can be discussed in the language of standard field theory. However, in this discussion it is essential to recognize that this effective action has a B.R.S. type symmetry of the form encountered in the quantization of gauge theories. It is then also possible to study finite size effects by adapting techniques developed for the static case in the cylindrical geometry. Some small scale numerical simulations have been done in the case of the 2D non linear sigma model to verify R.G. predictions with finite size effects.

42493 **(DOE/ER/40233—2) Topics in gauge theories and unification of elementary particle interactions: Progress report for period April 1, 1986-June 30, 1987.** Srivastava, Y.N.; Vaughn, M.T. (Northeastern Univ., Boston, MA (USA)). Jun 1987. Contract FG02-85ER40233. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012206.

Work is reported on: minjets and the rise of the total cross-section in QCD; quantum electrodynamic effects in macroscopic circuits; experimental search for electroweak effects in circuits; baryonium states with heavy quarks; E_8 superpotentials and heterotic string phenomenology; and computer graphic representations of solutions to classical field equations.

42494 **(EFI—841(68)-85) Radiative decays of charmonium P-levels in quantum chromodynamics.** Dulyan, L.S.; Oganesyan, A.G.; Khodzhamiryan, A.Yu. (Erevanskij Fizicheskij Inst. (USSR)). 1985. 25p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702692.

The gluonic power corrections to quantum chromodynamics sum rules for $chi_0(3415)$ charmonium $^3P_0$-level radiative decays are calculated. The widths of $chi_0 \to J/psi\gamma$, 2γ, $e^+e^-\gamma$ decays are predicted.

42495 **(EFI—842(69)-85) Non-local gauge field theory.** Bagdasaryan, I.A. (Erevanskij Fizicheskij Inst. (USSR)). 1985. 20p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702693.

The non-local quantum field theory, finite at a fixed elementary length l and based on the non-abelian gauge group SU(N)xU(1), is built up. A principle possibility of calculating the form factor is shown. As an illustration the vacuum polarization operator is considered.

42496 **(EFI—846(73)-85) Axial anomalies in external tensor fields.** Khudaverdyan, O.M.; Mkrtchyan, R.L.; Zurabyan, L.A. (Erevanskij Fizicheskij Inst. (USSR)). 1985. 26p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87702696.

Computation of the axial anomaly for Dirac fermions in external tensor fields is studied. The sequence of the supersymmetric one-dimensional models is presented. Their supercharges are equal, after quantization, to Dirac operators in external tensor fields, and the density of Witten's partition function gives the anomaly. It is shown that action in the corresponding path integral differs from the classical one. Gaussian approximation gives the anomaly only in the case of third-rank tensor with zero exterior derivative and in that case anomaly is calculated in all dimensions. The interpretation of that field as the torsion of gravitational field and also connection with the results of Witten and Alvarez-Gaume and Atiyah-Singer index theorem are discussed.

42497 **(IC—86/224) Integral octonions and E_8.** Koca, M. (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1986. 13p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702574.

240 non-zero roots of E_8 are constructed a la Dickson and Coxeter by defining simple roots in terms of octonionic units. They close under subtraction and multiplication. It is noted that the integral octonions of norms 1, 2,...,13 which constitute the dominant weights of unit multiplicity of certain representations of E_8 define Gosset's polytope in 8 dimensions. Similar features of integral quaternions forming the SO(8) root lattice are briefly mentioned. 13 references, 3 figures, 1 table.

42498 **(IC—86/264) Stochastic quantization and random surface approach to Polyakov string theory.** Koh, I.G.; Zhang, R.B. (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1986. 31p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87702580.

Polyakov string theories are quantized by stochastic methods. Langevin equations for string coordinate and two-dimensional metric are invariant under general coordinate transformation and Weyl scaling. In these methods, conformal anomaly contributed by string coordinate and scattering amplitudes of N-tachyons in the tree level are computed. As a first step of analytic computation in the random surface approach of the Polyakov string, the authors evaluate the tachyonic mass and the scattering amplitude for right triangles. 18 references, 1 figure.

42499 **(IC—86/269) General solution of chiral model in 1+1 dimensions.** Xie Yanbo. (International Centre for Theoretical Physics, Trieste (Italy)). Oct 1986. 10p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702581.

A constraint condition on the wavefunction of fermion particle is derived from the classical equation of motion in the chiral model, and the general solution is obtained in 1+1 dimensions. 4 references, 2 figures.

42500 **(IC—86/293) Bound states in quantum field theory and coherent states: a fresh look.** Misra, S.P. (International Centre for Theoretical Physics, Trieste (Italy)). Sep 1986. 11p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702591.

The authors consider here bound state equations in quantum field theory where the state explicitly includes radiation quanta as constituents with the number of such quanta not fixed. The fully interacting system is dealt with through equal time commutators/anticommutators of field operators. The multiparticle channel for the radiation field is approximated through coherent state representations. 8 references.

42501 **(IFVE-OTF—86-126) Spontaneous symmetry breaking in N=2 supergravity.** Zinov'ev, Yu.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 8p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702749.

A model describing the N=2 supergravity interaction with vector and linear multiplets is constructed. It admits the introduction of the spontaneous breaking of supersymmetry with arbitrary scales, one of which may be equal to zero, which corresponds to partial super-Higgs effect (N=2 -> N=1). A cosmological term is automatically equal to zero. 10 references.

42502 **(IFVE-OTF—86-171) Spontaneous symmetry breaking in N=3 supergravity.** Zinov'ev, Yu.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 14p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702753.

The possibility of the spontaneous symmetry breaking without a cosmological term in N=3 supergravity is investigated. A new, dual version of N=3 supergravity - U(3)-supergravity is constructed. Such a theory is shown to admit a spontaneous supersymmetry breaking without a cosmological term and with three arbitrary scales, including partial super-Higgs effect N=3 -> N=2 and N=3 -> N=1. 6 references.

42503 **(INIS-BR—667) Massive Yang-Mills fields in the Kemmer's formulation.** Santana Cordolino, L.A. de. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1984. 82p. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. File Number DE87702775.

The Kemmer's equation, which describes the meson, is presented in the field theory formalism. Conservated, quantities are found through the Noether's identity. This formalism is used for massive Yang-Mills fields and two equations, similar to the Kemmer's equation, are obtained, although of different formates, both containing quadratic terms. In consequence two Lagrangians are defined, formally distinct, for the Yang-Mills fields. The Schroedinger-like Hamiltonian is calculated for the first wave equations. This Hamiltonian presents one spin-Yang-Mills field interaction term, PHI/sub jk/.

42504 (JINR—D-10-11-84-818, pp 386-391) **Numerical experiment in the investigation of nonlinear evolution equations.** Makhan'kov, V.G.; Shvachka, A.B. 1985. (In Russian). NTIS (US Sales Only), PC A16/MF A01. File Number DE87780164. (CONF-8309402—).

From 5. international meeting on problems of mathematical simulation, programming, and mathematical methods for solving the physical problems; Dubna, USSR (20 Sep 1983).

The results of studying the dynamical properties and stability of multi-dimensional solitons of classical fields within the frames of the Klein-Gordon and Schroedinger nonlinear equations are given. As a result of numerical simulation of interactions of soliton-like objects the following four types of interactions are established: 1) elastic and quasielastic quasisoliton interactions; 2) decay of quasisolitons having interacted with each other; 3) decay through a short-living bound state; 4) a long-living bound state of two quasisolitons. 18 refs.

42505 **(LBL—23247) Derivative expansion of the effective action.** Cheyette, O. (Lawrence Berkeley Lab., CA (USA)). Apr 1987. Contract AC03-76SF00098. 22p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87012879.

This paper describes some methods for calculating derivative terms in the one loop effective action for a quantum field theory. The functional approach and background field method are first used to derive the general form of the one loop determinant. Then the determinant is expanded in powers of derivatives of the background fields. The form of this expansion is described for the simple case of an interacting scalar field, and then for the more complicated problem of a non-abelian gauge field. Finally, the expansion is applied to the task of calculating Higgs mass dependent effects in the Glashow-Weinberg-Salam model, and all terms which grow with the Higgs mass M/sub H/ are found in the one loop approximation. The result of this calculation is used to find the dependence of the gauge boson mass ratio rho on M/sub H/, and also to estimate the size of corrections to W and Z scattering theorems.

42506 **(SLAC-PUB—4344) Fayet-Iliopoulos D terms in string theory.** Sen, A. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Jun 1987. Contract AC03-76SF00515. 8p. (CONF-8703143—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012831.

From Workshop on superstrings, composite structures, and cosmology; College Park, MD, USA (11 Mar 1987).

One loop scalar masses induced by Fayet-Ilipoulos D terms in string theory are calculated directly in the heterotic string theory for an arbitrary compactification which preserves space-time supersymmetry at the string tree level. The result is shown to be a total derivative in the moduli space of a torus with two punctures, and hence receives contribution only from the boundary of this moduli space.

42507 **Confinement at large-N.** Klinkhamer, F.R. (Nuclear Science Div., Lawrence Berkeley Lab., Univ. of California, Berkeley, CA 94720). pp 29-48 of Quark confinement and liberation: Numerical results and theory. Klinkhamer, F.R.; Halpern, M.B. Teaneck, NJ; World Scientific Pub. Co. (1985).

Recent numerical results indicate that QCD in the limit of an infinite number (N) of colors also has confinement and moreover that it looks rather similar to normal QCD with N = 3 colors. This imposes severe restrictions on what the mechanism of confinement can be.

42508 **Physics in 10 and 11 dimensions.** Freund, P.G.O. (The Rockefeller Univ., New York, NY 10021). pp 1-10 of New trends in particle theory. Lusanna, L. Teaneck, NJ; World Scientific Pub. Co. (1985).

Unifications of gravity with all other forces and forms of matter in an 11-dimensional supersymmetric string theories are presented. The phenomenological and conceptual advantages of the latter and some open problems are noted.

65 PHYSICS II

REFER ALSO TO CITATION(S) 41627

6510 Nuclear Physics

REFER ALSO TO CITATION(S) 41689, 42883

42509 (ANL-PHY—86-1, pp 1-26) **Experimental overview of sub-barrier fusion.** Beckerman, M. (Joint Institute for Heavy Ion Research, Oak Ridge, TN). 1986. NTIS, PC A99/MF A01. File Number DE87010055. (CONF-860396—). Contract AS05-76ER04936.

From Symposium on the many facets of heavy ion fusion reactions; Argonne, IL, USA (24 Mar 1986).

An experimental overview of sub-barrier fusion data for many heavy ion systems is presented. The author focuses on structural variations and correlations with many-body properties, especially the effects occurring near closed-shells. Data on fusion cross sections, excitation functions and Q-values for neutron transfer are reviewed. Scaling with mass number is discussed.

42510 **(DOE/ER/40315—142) Experimental medium energy physics: Annual progress report, June 1986-May 1987.** (Carnegie-Mellon Univ., Pittsburgh, PA (USA)). 1987. Contract FG02-87ER40315. 101p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87012752.

During the past year the Carnegie Mellon University (CMU) Medium Energy Physics Group activities included five experimental programs, each at different stages of development. The analyses of data from two previous experiments were completed over the last year; a recent doctoral thesis represents a milestone in our study of the weak decays of hypernuclei. Software and hardware support was continued and data analysis initiated for the two experiments which received running time during this period. The status of the H dibaryon search proposals changed from conditional approval to full approval when funds were allocated for the new kaon beam line required for the experiments. The measurements of anti ΛΛ production at LEAR (PS-185) have been completed. A study of the polarization and angular distributions near threshold have been submitted for publication and an analysis of a CP test of the decay asymmetry parameters is complete. Results of data taken last year are being finalized. The analysis of data on the decay of ^{5}/sub Λ/He (AGS E-788) taken at BNL has also been completed in the past year and a publication is in preparation. Last summer the focus of the PS185 collaboration shifted from anti ΛΛ to a search for evidence of the ξ(2230) using the anti pp → K/sub s/K/sub s/ channel. Modifications designed to increase the acceptance of the LEAR anti ΛΛ experimental apparatus for this reaction were completed and a scan of the energy region near 2230 MeV took place in August. The data from this experiment are being analyzed at CMU. The CMU group has had extensive involvement in an experiment to search for strangeness production relativistic heavy ion collisions (CERN NA36). CMU personnel have installed computer hardware and worked on the development of new software designed for the on-line monitoring. The work was completed in time for the first running of the experiment in November of 1986.

42511 **(INIS-mf—9935) Decree No. 84-667 of 17 July 1984 on the National Institute for Nuclear and Particle Physics under the National Centre for Scientific Research.** (International Atomic Energy Agency, Vienna (Austria)). 21 Jul 1984. 2p. (In French). NTIS (US Sales Only), PC A02/MF A01. File Number DE87780143.

This Decree repeals Decree No. 71-279 which had set up the National Institute for Nuclear and Particle Physics under the National Centre for Scientific Research (CNRS). The new Decree gives the Institute a different statute. It will no longer have a distinct legal personality and now becomes a department within the CNRS. The Institute carries out its work in agencies placed under the supervisory authority of the Minister for National Education and the Minister for Research, respectively, with the exception of activities involving the Atomic Energy Commission (CEA).

6511 Experimental Techniques

REFER ALSO TO CITATION(S) 41822, 42539, 42621

42512 **(CRN-PN—86-03) Experimental root mean square charge radii, isotope shifts, ground state magnetic dipole and electric quadrupole moments of $1 \leqq A \leqq 239$ nuclei.** Antony, M.S.; Britz, J. (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires). 1986. 76p. NTIS (US Sales Only), PC A05/MF A01. File Number DE87751819.

A compilation of experimental root-mean square radii, isotope shifts, ground-state magnetic dipole and electric quadrupole moments of nuclei $1 \leqq A \leqq 239$ is presented. Shell, sub-subshell closures and changes in nuclear deformations discernible from data are displayed graphically. the nuclear charge distribution, for $1 \leqq A \leqq 239$ nuclei deduced from Coulomb displacement energies is shown for comparison.

42513 **(JINR-R—10-86-381) Program to calculate corrections for ionization losses in the spectra of nuclear reaction products.** Gorshkova, N.L.; Denisenko, K.G.; Murin, Yu.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1986. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702838.

The package of programs adapted for the ES-1055M and SM-4 computers and applied for processing the data on nuclear fragmentation has been developed. It is shown that corrections for ionization losses lead not only to an energy shift but also to a significant nonlinear transformation of the spectra of fragments with Z=2-15 produced in p + Au and ^{4}He + Au collisions with energies of 1-20 MeV per nucleon. The characteristic value of energy losses for the considered range of charges, energies, target widths and materials ((CH^2)/sub n/, Al, Si and Au) is of the order of 20%. 4 references, 2 figures, 1 table.

42514 **Magnetically insulated diode for generating pulsed neutron and gamma ray emissions.** Kuswa, G.W.; Leeper, R.J. (to Dept. of Energy, Washington, DC). US Patent 4,675,145. 23 Jun 1987. Filed date 16 Aug 1984. vp.

A magnetically insulated diode is described comprising: (a) a first cylinder defining an anode; (b) a second cylinder defining a cathode in predetermined spaced relationship to the anode. The cathode cooperates with the anode to form an acceleration gap. One of the anodes or cathodes are disposed within and axially aligned with the other of the anodes or cathodes; (c) a target material for receiving accelerated ions, the target material is disposed adjacent the cathode; (d) means for maintaining a vacuum in the space between the anode and the cathode; (e) means for applying an electrical potential between the anode and the cathode; (f) magnet means, positioned only within the outermost of the cylinders, for producing a magnetic field that lies between and primarily parallel to the cylindrical surfaces of the anode and cathode for inhibiting electron flow; and (g) means for producing ions in the vicinity of the anode, the ions are accelerated across the acceleration gap and into the target material by the electrical potential.

42515 **Hypernuclear research at the AGS.** Chrien, R.E. (Brookhaven National Lab., Upton, NY 11973). pp 569-600 of Nuclear spectroscopy and nuclear reactions. Ejiri, H.; Fukuda, T. Teaneck, NJ; World Scientific Pub. Co. (1984). (CONF-840312—).

From Conference on the changing structure of the world oil industry; Guildford, UK (22 Mar 1984).

In this paper, the aim is to describe the evolution of hypernuclear research, stressing especially the contributions of the program based on the Brookhaven AGS. Further advances in the study of hypernuclei were strongly inhibited by the lack of adequate spectrometer resolution. To overcome this limitation, a double-armed spectrometer was used. The results of experiment and predictions indicates that, in general, the splitting of the hypernuclear spin-dependent multiplets is small, and further, that they result from the superposition of several terms of various signs and magnitudes. In conclusion, the development of hypernuclear research has been dependent on several key technical developments. These include the production of good quality separated beams, the development of one and two-armed spectrometers, and the increase in available kaon intensities. The future of hypernuclear research depends on the continued availability of such beams and their improvement. At least an order of magnitude intensity increase, while maintaining a favorable K to π ratio, is required to explore the exotic possibilities of doubly strange systems. Future research in the Y-ray spectroscopy of hypernuclei also depends on further intensity increases.

6512 Nuclear Properties And Reactions, A=1-5, Experimental

42516 **(LA-UR—87-2036) Multiple scattering in pion-helium-3 scattering.** Klein, A.; Egger, J.P.; Gysin, C.; Henneck, R.; Jourdan, J.; Pickar, M.; Plattner, G.R.; Sick, I. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 3p. (CONF-8708102—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011771.

From Pion nucleus physics: future directions and new facilities at LAMPF workshop; Los Alamos, NM, USA (17 Aug 1987).

For a deeper understanding of the pion-nucleus interaction it is desirable to obtain a microscopic description of the various steps in the formation, propagation and decay of the intermediate delta. To achieve this goal, studies of the simplest (few nucleon) nuclei are the best tools. ^{3}He, the nucleus investigated in this experiment, is the simplest nucleus besides the weakly bound deuteron. We here report on an inclusive and exclusive pion scattering experiment ^{3}He(π/sup +-/,π/sup +-,/)X and ^{3}He(π/sup +-/,π/sup +-,/,p)X in the energy region 170 to 320 MeV. The experiment was performed at SIN using the SIN universal spectrometer installation (SUSI) and an additional plastic scintillator for the exclusive measurements. The target consisted of a liquid ^{3}He cell thermally coupled to liquid ^{4}He. 4 refs., 2 figs.

6513 Nuclear Properties And Reactions, A=6-19, Experimental

42517 (ANL-PHY—86-1, pp 325-342) **Multiple heavy-fragment breakup reactions.** Pelte, D. (Physikalisches Institute der Universitaet Heidelberg, West Germany). 1986. NTIS, PC A99/MF A01. File Number DE87010055. (CONF-860396—).

From Symposium on the many facets of heavy ion fusion reactions; Argonne, IL, USA (24 Mar 1986).

Data for heavy ion breakup reactions for projectiles between silicon 28 and argon 40 and targets between carbon 12 and zirconium 90 in the energy range 7 to 15 MeV/n are presented. The experimental method used to cope with the complexity of the exit channels in these reactions is discussed. Data on cross sections, isotopic distribution, charge distribution, energy dependence, Q-value and angular momentum of the target are discussed in relationship to model predictions.

42518 (ANL-PHY—86-1, pp 495-502) **Symmetric fission of ^{24}Mg.** Fulton, B.R.; Bennett, S.J.; Ogilvie, C.A.; Lilley, J.S.; Banes, D.W.; Rae, W.D.M.; Allcock, S.C.; Betts, R.R.; Smith, A.E. (Univ. of Birmingham, England). 1986. NTIS, PC A99/MF A01. File Number DE87010055. (CONF-860396—).

From Symposium on the many facets of heavy ion fusion reactions; Argonne, IL, USA (24 Mar 1986).

In this contribution we present preliminary results of a measurement of the fission of ^{24}Mg into two ^{12}C nuclei following inelastic excitation of ^{24}Mg projectiles scattered from a light target. The use of a heavy ion inelastic scattering reaction preserves the connection to the ^{24}Mg ground state configuration, and the high initial ^{24}Mg momentum provides considerable kinematic focussing, yielding high efficiency for detecting the breakup fragments. The data show distinct structure as a function of ^{24}Mg excitation over an energy range similar to that observed in ^{12}C + ^{12}C scattering.

42519 (ANL-PHY—86-1, pp 549-554) **Experimental test for non-fusion strength in the heavy residues emitted in the ^{11}B + ^{12}C reaction.** Mateja, J.F.; Frawley, A.D.; Parker, R.A; Sartor, K. (Tennessee Technological Univ., Cookeville). 1986. NTIS, PC A99/MF A01. File Number DE87010055. (CONF-860396—).

From Symposium on the many facets of heavy ion fusion reactions; Argonne, IL, USA (24 Mar 1986).

The present experiment was performed to determine whether or not the heavy residues from the boron 11 + carbon 12 system result from the fusion-evaporation of the sodium 23 compound nucleus formed in the reaction. Experiments were done at the FSU tandem Van de Graaff accelerator at a center of mass energy of 25 MeV. The experimental method is described. The outgoing heavy residues were identified by mass and energy spectra were measured as function of mass and angular distribution. The technique was able to distinguish between direct and fusion events.

42520 **(CTA-IEAV-NT—02/85) Utilization of the Rutherford backscattering technique for precise measurements of thickness by an alternative procedure.** Chagas, E.F.; Acquadro, J.C.; Liguori Neto, R.; Carlin Filho, N.; Gomes, P.R.S.; Coimbra, M.M. (Centro Tecnico Aeroespacial, Sao Jose dos Campos (Brazil). Inst. de Estudos Avancados). 27 Mar 1985. 11p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702669.

This technique was used to determine the thickness of targets on very thick substrates as this type of target is used a lot in nuclear physics, and especially in γ spectroscpy. The difficulties introduced in this case, occur because of the appearance of a small peak on a very high continuous background, due to the fact that the atomic number of the substrate is bigger than that of the targets. These difficulties are overcome using an alternative procedure to determine precisely the loss of energy of the beam whilst crossing the refered target. Targets of ^{59}Co,/sup 46-48-50/Ti and ^{10}B on substrate of Pd and Ta, with thicknesses betwnn 30μg/cm^2 and 500μg/cm^2 were measured with a precision of 5%. The biggest sources of imprecision are the amounts of dE/dX.

42521 **(EFI—838(65)-85) Quasi-elastic electron scattering (e,e'p) on ^{8}Be and ^{28}Si nuclei.** Bagdasaryan, D.S.; Vartapetyan, G.A.; Galumyan, P.I.; Kazaryan, G.B.; Karibyan, M.D.; Markaryan, Eh.R.; Manukyan, G.A.; Mkrtchyan, G.G. (Erevanskij Fizicheskij Inst. (USSR)). 1985. 14p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702689.

The first results of the (e, e'p) reaction yield on ^{8}Be and ^{28}Si nuclei as a function of the proton emission angle at Q^2—0.2 GeV^2/c^2 in the quasi-elastic peak region are obtained on the beam of the Yerevan electron synchrotron. The measurement technique and the preliminary results are presented.

42522 (INIS-mf—10911, pp 16) **Angular distributions in the maximum alpha yield for /sup 18/O (p,α ≧ o)/sup 15/N reaction at 846 keV.** Cohen, D.D.; Katsaros, A.; Frisken, S. (Australian Inst. of Nuclear Science and Engineering, Lucas Heights; New South Wales Univ., Kensington, Australia. School of Physics). 1986. NTIS (US Sales Only), PC A06/ MF A01. File Number DE87702489. (CONF-860233— Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

42523 **(ZfK—607) Diffraction scattering of alpha particles on C, Al, Cu and Pb at 17.9 GeV/c.** Ableev, V.G.; Naumann, B.; Nomofilov, A.A.; Piskunov, N.M.; Sharov, V.I.; Sitnik, I.M.; Strokovsky, E.A.; Strunov, L.N.; Vorob'ev, G.G.; Zaporozhets, S.A. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). Nov 1986. 14p. NTIS (US Sales Only), PC A02/ MF A01. File Number DE87702881.

New data on the diffraction scattering of relativistic alpha particles on C, Al, Cu and Pb targets at incident momentum of 17.9 GeV/c are presented. Differential cross sections at four-momentum transfers squared chemical bondtchemical bond ranging from 0.038 (GeV/c)/sup 2/ up to 0.55 (GeV/c)/sup 2/ have been measured with an accuracy of 3% of the absolute normalization. These data are compared with the predictions of the Glauber-Sitenko multiple scattering theory.

6514 Nuclear Properties And Reactions, A=20-38, Experimental

42524 (ANL-PHY—86-1, pp 219-236) **Study of incomplete fusion for light heavy-ion systems using velocity distributions.** Chan, Y.; Albiston, C.; Bantel, M.; Budzanowski, A.; DiGregorio, D.; Stokstad, R.G.; Wald, S.; Zhou, S.; Zhou, Z. (Lawrence Berkeley Lab., CA). 1986. NTIS, PC A99/MF A01. File Number DE87010055. (CONF-860396—). Contract AC03-76SF00098.

From Symposium on the many facets of heavy ion fusion reactions; Argonne, IL, USA (24 Mar 1986).

Experimental results from the 88-inch cyclotron at Lawrence Berkeley Laboratorn on incomplete fusion for light systems by studying the velocity distribution of fusion-like residues in the energy range 6-20 MeV/nucleon are reported. The reactions involved nitrogen 14, oxygen 16, fluorine 19 and neon 19 projectiles on magnesium 24, aluminium 27, silicon 28, calcium 40, nickel 58 and nickel 60 targets. Data for several important features of the observed velocity-centroid shifts are summarized and the systematics of incomplete fusion are discussed. Results are interpreted in light of reaction models.

42525 (ANL-PHY—86-1, pp 433-440) **Fusion of aligned ^{23}Na with ^{23}Na.** Blatt, K. (Philipps-Universitaet, Marburg, West Germany). 1986. NTIS, PC A99/MF A01. File Number DE87010055. (CONF-860396—).

From Symposium on the many facets of heavy ion fusion reactions; Argonne, IL, USA (24 Mar 1986).

The limitation of the fusion cross section at high energies is one of the open problems in heavy ion fusion research. Two completely different concepts were proposed to explain this limitation: one related to the entrance channel properties of the two fusing nuclei and the other related to the compound nucleus properties. Here the author presents a new tool to investigate the observed limitation: the use of aligned heavy ion beams of deformed nuclei. The measurement of the 2nd rank tensor analyzing power T_{20}, a pure entrance channel quantity, tests the sensitivity of the fusion cross section on the alignment of the deformed projectile. Any interpretation of a compound nucleus model has therefore to predict a vanishing tensor analyzing power T_{20} because the orientation of the alignment axes of one of the reaction partners cannot effect the fusion cross section if it is determined exclusively by the properties of the compound nucleus. Calculations within a particular entrance channel model, the socalled surface friction model, on the other hand predict small but nonvanishing values of the analyzing power T_{20}. Using the Heidelberg polarized ^{23}Na beam, the tensor analyzing power T_{20} for the fusion of ^{23}Na with ^{23}Na was measured at E/sub Lab/ = 170 MeV. The analyzing power turned out to be zero (T_{20} = -0.0060 +/- 0.0125) within the error bar, consistent with a compound nucleus explanation for the limitation of fusion, while the surface friction model fails to reproduce the value of T_{20}.

42526 (ANL-PHY—86-1, pp 525-532) **Complete and incomplete fusion in ^{56}Ni compound nuclear systems.** Hinnefeld, J.D.; Kolata, J.J.; Henderson, D.J.; Janssens, R.V.F.; Kovar, D.G.; Lesko, K.T.; Rosner, G.; Stephans, G.S.F.; van den Berg, A.M.; Wilkins, B.D.; Prosser, F.W. (Univ. of Notre Dame, IN). 1986. NTIS, PC A99/MF A01. File Number DE87010055. (CONF-860396—).

From Symposium on the many facets of heavy ion fusion reactions; Argonne, IL, USA (24 Mar 1986).

Time-of-flight measurements of evaporation residues produced in reactions of ^{16}O + ^{40}Ca, ^{28}Si + ^{28}Si, and ^{32}S + ^{24}Mg, at energies of 5-10 MeV/nucleon reveal a much larger contribution from incomplete fusion processes in the highly asymmetric ^{16}O + ^{40}Ca system than in the other two systems at the higher energies. This large contribution from incomplete fusion in ^{16}O + ^{40}Ca obscures limitations to the complete fusion cross section resulting from properties of the ^{56}Ni compound nucleus, which are evident in the other two entrance channels.

42527 (ANL-PHY—86-1, pp 569-576) **Fusion-evaporation cross sections for ^{24}Mg + ^{24}Mg at 5 < E/sub lab/ < 9 MeV/A^{+}.** Prosser, F.W.; Reinert, S.V.; Kovar, D.G.; Rosner, G.; Stephans, G.S.F.; Kolata, J.J.; Szanto de Toledo, A.; Szanto, E. (Univ. of Kansas, Lawrence). 1986. NTIS, PC A99/MF A01. File Number DE87010055. (CONF-860396—).

From Symposium on the many facets of heavy ion fusion reactions; Argonne, IL, USA (24 Mar 1986).

The purposes of this experiment were to study limits to the fusion-fission cross section in a light system and to look for evidence of incomplete fusion. The system magnesium 24 + magnesium 24 was studied at three energies, 110, 159, and 205 MeV using the booster section of ATLAS. Fusion cross sections, angular distributions, residue yields, velocity distributions and mass spectra were measured. Results are compared to theoretical predictions.

42528 (ANL-PHY—86-1, pp 577-588) **Fusion-fission in the ^{16}O + /sup 40,44/Ca and ^{32}S + ^{24}Mg reactions.** Sanders, S.J.; Back, B.B.; Betts, R.R.; Dichter, B.K.; Kaufman, S.; Kovar, D.G.; Wilkins, B.; Videbaek, F. 1986. NTIS, PC A99/MF A01. File Number DE87010055. (CONF-860396—).

From Symposium on the many facets of heavy ion fusion reactions; Argonne, IL, USA (24 Mar 1986).

In measurements of fully-damped yields for the ^{16}O + /sup 40,44/Ca and ^{32}S + ^{24}Mg reactions, they find evidence for a fusion-fission reaction mechanism. The experiments were performed at the Argonne tandem-linac booster facility. Reaction products with masses 22 < A < 36 for the ^{16}O + /sup 40,44/Ca reactions and 10 < A < 28 for the ^{32}S + ^{24}Mg reaction were detected and identified using the time-of-flight technique. The ^{16}O + /sup 40,44/Ca reactions were measured at several center-of-mass energies for 49.5 to 62.5 MeV, while the ^{32}S + ^{24}Mg data were obtained at a single energy of E/sub cm/ = 60 MeV. The resulting total kinetic energies (calculated assuming two-body kinematics), angular distributions, and mass distributions of the fragments are found to be consistent with a fusion-fission reaction mechanism. An alternative explanation of the yields in terms of a deep-inelastic scattering mechanism is ruled out by the asymmetric nature of the mass distributions: the maximum cross section for the ^{32}S + ^{24}Mg reaction is detected in the mass 12 channel whereas the maximum cross sections for deep-inelastic scattering would be expected to occur near the target-projectile mass partition. For the ^{32}S + ^{24}Mg reaction at E/sub cm/ = 60 MeV, the fission cross section is found to be approximately 6% of the evaporation-residue cross section. These results indicate that at higher energies fission competes with light particle evaporation in compound nuclear decay - even in these light systems.

42529 **Proton resonances in /sup 24/Mg from E/sub x/ = 12.7 to 15.7 MeV.** Vanhoy, J.R.; Bilpuch, E.G.; Westerfeldt, C.R.; Mitchell, G.E. (Duke University, Durham, North Carolina 27706). *Physical Review [Section] C: Nuclear Physics;* **36**: No. 3, 920-932(Sep 1987).

The /sup 23/Na(p,p_0), (p,p_1), (p,α_0), and (p,α_1) differential cross sections were measured in the energy range E/sub p/ = 1.08—4.15 MeV with an overall resolution of 400 eV full width at half maximum. Resonance parameters were obtained for 94 levels with a multilevel, multichannel R-matrix code; parameters include resonance energy, total angular momentum, proton and alpha partial widths, and channel spin and orbital angular momentum mixing ratios. The observed proton and alpha resonance widths provide an upper limit for /sup 12/C+/sup 12/C reaction rates for an energy region where there are no direct measurements.

42530 **Resonance behavior in the /sup 24/Mg+/sup 28/Si system.** Wuosmaa, A.H.; Saini, S.; Kutt, P.H.; Pate, S.F.; Zurmuehle, R.W.; Betts, R.R. (Physics Department, University of Pennsylvania, Philadelphia, Pennsylvania 19104). *Physical Review [Section] C: Nuclear Physics;* **36**: No. 3, 1011-1015(Sep 1987).

We have measured excitation functions for elastic and inelastic scattering of the nonsymmetric alpha-particle system of /sup 24/Mg+ /sup 28/Si, in the energy range 90.95 MeV<E/sub lab/<106.25 MeV. We observe narrow structures similar to those seen in the nearby /sup 24/Mg+ /sup 24/Mg and /sup 28/Si+ /sup 28/Si systems. Elastic scattering angular distributions reflect the contribution of two or three l values for structures at E/sub c.m./ = 50.51 and 52.53 MeV, with the dominant partial waves in the range of l = 33 to 38 h-dash-bar. A statistical fluctuation analysis of the data for the low lying excitations confirms the nonstatistical nature of these resonances.

6515 Nuclear Properties And Reactions, A=39-58, Experimental

42531 (ANL-PHY—86-1, pp 451-458) **Does a heavy-ion reaction process intermediate between fusion and damped reactions exist?.** Butler, M.A.; Datta, S.S.; deSouza, R.T.; Huizenga, J.R.; Schroeder, W.U.; Toke, J.; Wile, J.L. (Univ. of Rochester, NY). 1986. NTIS, PC A99/MF A01. File Number DE87010055. (CONF-860396—).

From Symposium on the many facets of heavy ion fusion reactions; Argonne, IL, USA (24 Mar 1986).

Experiments are reported which investigate nuclear fragments with properties intermediate between those characterizing damped and fusion-fission processes. A nickel 58 target was bombarded by holmium 165 ions at energies between 970 and 1400 MeV at the SuperHILAC. The mass and angular distribution of the fragments from the reaction were measured. The experimental setup is described and cross sections are reported as a function of mass and angle.

42532 (ANL-PHY—86-1, pp 555-562) **Transfer cross sections for /sup 32,36/S + /sup 58,64/Ni around the Coulomb barrier.** Montagnoli, G.; Stefanini, A.M.; Fortuna, G.; Menegazzo, R.; Beghini, S.; Signorini, C.; DeRosa, A.; Inglima, G.; Sandoli, M.; Rizzo, F.; Pappalardo, G. (INFN-Laboratori Nazionali di Legnaro, Padova, Italy). 1986. NTIS, PC A99/MF A01. File Number DE87010055. (CONF-860396—).

From Symposium on the many facets of heavy ion fusion reactions; Argonne, IL, USA (24 Mar 1986).

The cross sections for quasi-elastic nucleon transfer in the four systems, /sup 32,36/S + /sup 58,64/Ni at three energies around the Coulomb barrier have been measured. This study was mainly motivated by the previous measurements of the fusion excitation functions for the same systems down to the sub-barrier energy range. Large sub-barrier fusion probabilities were found, as well as strong isotopic effects which were suggested to be related with the availability, in some cases, of neutron transfer channels with positive ground state Q-value. The experiments were carried out using /sup 32,36/S beams from the XTU Tandem accelerator of Legnaro National Laboratory, at energies from 94 up to 112 MeV.

42533 (INIS-mf—10925) **Single-particle properties of ^{51}V and ^{90}Zr studied with the (e,e'p) reaction. Towards absolute spectroscopic factors.** Herder, J.W.A. den. (Amsterdam Univ. (Netherlands)). 18 Feb 1987. 130p. NTIS (US Sales Only), PC A07/MF A01. File Number DE87702792.

This thesis is organized as follows. In chapter 2 the relation between the (e,e'p) coincidence cross section and the nuclear structure information is presented. The formalism to calculate the final-state interaction between the outgoing proton and the residual nucleus is introduced. The distortion of the electron in the Coulomb field of the nucleus is discussed as well and the effect of various descriptions of the electron-proton coupling on the (e,e'p) results is presented. In chapter 3 a short description of the experimental setup is given including the experimental parameters pertinent to the present experiment. Chapter 4 deals with the data taking and the subsequent analysis including the calibration techniques and the systematic error. In chapter 5 information about the effect of the final-state interaction on the momentum distributions measured in the (e,e'p) reaction is discussed in detail. Particular attention is given to the effect of different optical potentials in connection with the analysis of elastic proton scattering data. In chapter 6 and 7 the results for the reactions ^{51}V(e,e'p)^{50}Ti and ^{90}Zr(e,e'p)^{89}Y are presented, respective0326Spectroscopic factors, occupation numbers and the rms radii of the individual proton orbits are presented and compared to theory. Finally in chapter 8 the main conclusions concerning the spectroscopic factors and the occupation probability of protons in orbits at and just below the Fermi surface are summarized. 105 references, 64 figures, 22 tables.

42534 **Pion elastic and inelastic scattering from /sup 51/V at 180 MeV.** Oakley, D.S.; Machuca, M.A.; Smithson, M.J.; Mordechai, S.; Moore, a.C.F.; Seidl, P.A.; Morris, C.L.; Wang, Z.F.; Gilman, R.; Zumbro, J.D.; and others. (University of Texas at Austin, Austin, Texas 78712). *Physical Review [Section] C: Nuclear Physics;* **36**: No. 3, 1074-1080(Sep 1987).

Differential cross sections were measured for pion elastic and inelastic scattering from /sup 51/V at T/sub π/ = 180 MeV. Elastic scattering data were analyzed using a standard Kisslinger potential. Inelastic scattering data were analyzed using distorted-wave impulse-approximation calculations with collective-model transition densities. Ground-state neutron-density parameters and matrix elements for some of the transitions were extracted.

6516 Nuclear Properties And Reactions, A=59-89, Experimental

42535 (ANL-PHY—86-1, pp 27-48) **Influence of quasi-elastic channels on fusion.** Rehm, K.E. 1986. NTIS, PC A99/MF A01. File Number DE87010055. (CONF-860396—).

From Symposium on the many facets of heavy ion fusion reactions; Argonne, IL, USA (24 Mar 1986).

Several experiments performed at Argonne National Laboratory to measure the strength of transfer reactions in heavy ion systems near the barrier are described. These experiments involve projectiles from silicon 28 to selenium 80 on a variety of targets between nickel 58 and lead 208. Data on cross sections, angular distributions, mass spectra and Q-values are presented. The main features of the transfer reactions are summarized including which are the strongest channels and what is their system and energy dependence.

42536 (ANL-PHY—86-1, pp 467-476) **Limit to incomplete fusion in the ^{40}Ar + ^{68}Zn reaction.** Coffin, J.P.; Fahli, A.; Rami, F.; Guillaume, G.; Heusch, B.; Jundt, F.; Wagner, P.; Fintz, P.; Cole, A.J., Kox, S.; Schutz, Y. (Universite Louis Pasteur, Strasbourg, France). 1986. NTIS, PC A99/MF A01. File Number DE87010055. (CONF-860396—).

From Symposium on the many facets of heavy ion fusion reactions; Argonne, IL, USA (24 Mar 1986).

Incomplete fusion reactions in the system argon 40 + zinc 68 were investigated in low impact collisions in the energy range 584-1400 MeV at SARA and GANIL. Mass, velocity and yields of the outgoing fragments were measured and fusion cross sections obtained. The results show that incomplete fusion occurs in the

energy range of 15-35 MeV/n and vanishes at about 35 MeV/n. Comparison with other results shows that the linear momentum transfer depends on the energy and mass of the projectile and on the asymmetry of the system.

42537 (ANL-PHY—86-1, pp 563-568) **Experimental studies of the systems /sup 63,65/Cu + ^{16}O at energies near the Coulomb barrier.** Pereira, D.; Acquadro, J.C.; Sala, O. (Univ. of Sao Paulo, Brazil). 1986. NTIS, PC A99/MF A01. File Number DE87010055. (CONF-860396—).

From Symposium on the many facets of heavy ion fusion reactions; Argonne, IL, USA (24 Mar 1986).

In order to investigate target dependent behaviour we have studied fusion and quasi-elastic reaction channels for the system / sup 63,65/Cu + ^{16}O. Fusion cross sections were measured in the incident energy range 42 MeV ≦ E/sub LAB/ (^{16}O) ≦ 72 MeV using a time-of-flight method for detection and identification of the evaporation residues and an electrostatic deflector system to remove the beam-like particles. Angle integrated cross sections are shown. The data cover a bombarding energy range of 1.0 to 1.8 times the Coulomb barrier.

42538 **(INIS-mf—10610) Structure studies on /sup 82/Kr by means of the multiple Coulomb excitation.** Bruessermann, S. (Goettingen Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fachbereiche). 1 Nov 1985. 126p. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE87751868.

With a /sup 82/Kr beam of the energy 4.6 MeV per nucleon a /sup 208/Pb target was irradiated in order to study the Coulomb excitation of /sup 82/Kr. The experiment has been performed at the Society for Heavy Ion Research (GSI) in Darmstadt. The /sup 82/Kr ions backscattered on the /sup 208/Pb target were detected in a position-sensitive parallel-plate avalanche detector. The γ radiation of the excited /sup 82/Kr particles was detected in 4 Ge(Li) detectors in coincidence with the particles. The spectra corrected regarding the Doppler shift contained 16 lines which permitted to determine by means of known mixing and branching ratios 22 electrical quadrupole transition matrix elements. The experimental excitation energies and the transition probabilities determined in this thesis are compared with different nuclear models, like the asymmetric rotator model, the rotational-vibrational model, the harmonic-oscillator model, the nuclear field theory, the SU(5) limit of the IBA-1, and the IBA-2 model. Thereby within the IBA-2 model a criterium for the symmetry of the wavefunction relative to the proton and neutron contributions is elaborated. Because of this criterium to the 2/sub 1//sup +/ state a symmetric structure and to the 2/sub 2//sup +/, 3 states an asymmetric structure is assigned.

42539 **Overlapping β decay and resonance neutron spectroscopy.** Raman, S.; Fogelberg, B. (Oak Ridge National Lab., Oak Ridge, TN 37831). pp 102-106 of Nuclear spectroscopy and nuclear reactions. Ejiri, H.; Fukuda, T. Teaneck, NJ; World Scientific Pub. Co. (1984). (CONF-840312—).

From Conference on the changing structure of the world oil industry; Guildford, UK (22 Mar 1984).

By carrying out a detailed study of /sup 87/Kr levels, delayed neutron spectroscopy can be a viable method for studying individual levels and a broad resonance-like structure is shown to be present in the β-strength distribution.

6517 Nuclear Properties And Reactions, A=90-149, Experimental

42540 (ANL-PHY—86-1, pp 175-184) **Deviations from compound nucleus decay.** Kuehn, W. (Univ. Giessen, West Germany). 1986. NTIS, PC A99/MF A01. File Number DE87010055. (CONF-860396—).

From Symposium on the many facets of heavy ion fusion reactions; Argonne, IL, USA (24 Mar 1986).

The Darmstadt-Heidelberg crystal ball has been used to measure evaporation residue and compound nucleus angular momentum distribution for ^{156}Er formed via the two entrance channels ^{12}C + ^{144}Sm and ^{64}Ni + ^{92}Zr. In contrast to statistical model expectations, the population of various exit channels depends on the entrance channel mass asymmetry, when compared at the same excitation energy and angular momentum in ^{156}Er.

42541 (ANL-PHY—86-1, pp 185-194) **Dynamics in heavy ion fission - an experimentalist's view.** Gavron, A.; Gayer, A.; Boissevain, J.; Britt, H.C.; Nix, J.R.; Sierk, A.J.; Grange, P.; Hassani, S.; Weidenmueller, H.A.; Beene, J.R.; Cheynis, B. (Los Alamos National Lab., NM). 1986. NTIS, PC A99/MF A01. File Number DE87010055. (CONF-860396—).

From Symposium on the many facets of heavy ion fusion reactions; Argonne, IL, USA (24 Mar 1986).

The authors have investigated the effects of nuclear dynamics on neutron spectra emitted from a fissioning heavy ion system. They incorporate corrections to statistical model calculations due to dissipation effects and include neutron emission during the saddle-to-scission transition in their calculations. They are consequently able to reproduce enhanced neutron emission preceding fission which is observed experimentally.

42542 (ANL-PHY—86-1, pp 427-432) **Measurement of transfer reactions below the Coulomb barrier using a recoil mass separator.** Betts, R.R.; Evans, P.M.; Pass, C.; Poffe, N.; Smith, A.E.; Stuttge, L.; Lilley, J.S.; Banes, D.W.; Connell, K.; Simpson, J.; Smith, J.R. (Oxford Univ., England). 1986. NTIS, PC A99/MF A01. File Number DE87010055. (CONF-860396—).

From Symposium on the many facets of heavy ion fusion reactions; Argonne, IL, USA (24 Mar 1986).

Quantitative calculations of sub-barrier fusion reactions are usually carrier out in the coupled channel formalism. There are, however, several questions that arise concerning this picture of the reactions. To address these questions, transfer channels in the sub-barrier region have been measured in the system nickel 58 + tin over a range of energies from the nominal Coulomb barrier to 40 MeV below this energy. Some difficulties with making these measurements are discussed. Data are presented for yields and cross sections.

42543 (ANL-PHY—86-1, pp 441-450) **Mean-square spin value of the compound nucleus at near-barrier energies from evaporation residue angular distributions.** Borges, A.M.; Clemente, M.; Lenz, U.; Loebner, K.E.G.; Quade, U.; Rudolph, K.; Schomburg, W.; Skorka, S.J.; Steinmayer, M.; Weidl, I. (Universitaet Muenchen, Garching, West Germany). 1986. NTIS, PC A99/MF A01. File Number DE87010055. (CONF-860396—).

From Symposium on the many facets of heavy ion fusion reactions; Argonne, IL, USA (24 Mar 1986).

To provide information on the mean square spin values of compound nuclei from fusion reactions the angular distributions of evaporation residues from the fusion of sulfur 32 and sulfur 36 with several ruthenium, molybdenum and palladium isotopes have been measured at near barrier energies. The relative yields of the four most abundant exit evaporation channels have been extracted by fitting the angular distribution expected for each exit channel to the measured angular distribution. Experimental spin values are larger than expected from a standard no-coupling soft cutoff distribution and agree in the immediate vicinity of the barrier with coupled channel predictions. These predictions are exceeded, however, at energies 4-6 MeV above the barrier.

42544 (ANL-PHY—86-1, pp 487-494) **Subcoulomb fusion of ^{24}Mb with /sup 90,92,94,96/Zr and ^{32}S with /sup 92,98/Mo.** Ecker, R.D.; Friese, J.; Gillitzer, A.; Koener, H.J.; Mueller, L.; Rosner, G. (Technische Universitaet Muenchen, Garching, West Germany). 1986. NTIS, PC A99/MF A01. File Number DE87010055. (CONF-860396—).

From Symposium on the many facets of heavy ion fusion reactions; Argonne, IL, USA (24 Mar 1986).

Excitation functions of evaporation residue cross sections were measured around and below the fusion barrier for the reactions ^{24}Mg + /sup 90,92,94,96/Zr, E/sub lab/ = 68 - 96 MeV and ^{32}S + /sup 92,98/Mo, E/sub lab/ = 105 - 120 MeV using an electrostatic deflector. Calculations of the fusion cross sections were

performed including penetration through a one-dimensional barrier and coupling to the lowest-lying 2^+ and 3^- states in the target or the projectile. No quantitative agreement with the data could be achieved.

42545 (ANL-PHY—86-1, pp 503-510) **Investigations in the cold fusion reaction of 90ZR + 90ZR.** Gollerthan, U.; Clerc, H.G.; Schwab, W.; Armbruster, P.; Hessberger, F.P.; Keller, J.G.; Muenzenberg, G.; Schmidt, K.H.; Sahm, C.C.; Simon, R.S. (Institut fuer Kernphysik, Darmstadt, West Germany). 1986. NTIS, PC A99/MF A01. File Number DE87010055. (CONF-860396—).

From Symposium on the many facets of heavy ion fusion reactions; Argonne, IL, USA (24 Mar 1986).

An important topic in nuclear physics is the dynamical evolution of a system of two separate nuclei evolving into a compound nuclei. To study this process cross sections, excitation functions, gamma spectra and gamma multiplicity have been measured for the system zirconium 90 + zirconium 90. The experimental results are compared with statistical model calculations done with the Monte Carlo evaporation code CODEX. Results show that deexcitation of the fused system can be understood with the statistical model calculations.

42546 (ANL-PHY—86-1, pp 533-540) **Subbarrier fusion in the systems ^{90}Zr + ^{89}Y, /sup 90,92,96/Zr, ^{94}Mo.** Keller, J.G.; Schmidt, K.H.; Hebberger, F.P.; Muenzenberg, G.; Reisdorf, W.; Clerc, H.G.; Sahm, C.C. (Gesellschaft fuer Schwerionenforschung, Darmstadt, West Germany). 1986. NTIS, PC A99/MF A01. File Number DE87010055. (CONF-860396—).

From Symposium on the many facets of heavy ion fusion reactions; Argonne, IL, USA (24 Mar 1986).

Sub-barrier fusion was studied with zirconium projectiles on various intermediate mass targets in the energy range 160-200 MeV at the UNILAC facility. Single evaporation residues were identified and cross sections for different excitation channels were determined. Fusion probabilities averaged over angular momenta which give rise to the residues were determined. Barrier distributions for the systems considered were obtained. Results are compared to coupled channel calculations.

42547 (ANL-PHY—86-1, pp 541-548) **Fusion partial wave cross sections using TESSA.** Love, D.J.G.; Nelson, A.H.; Twin, P.J.; Bishop, P.J.; Kirwan, A.; Nolan, P.J.; Thornley, D.J. (Daresbury Lab., Warrington, England). 1986. NTIS, PC A99/MF A01. File Number DE87010055. (CONF-860396—).

From Symposium on the many facets of heavy ion fusion reactions; Argonne, IL, USA (24 Mar 1986).

The TESSA spectrometer is described and the current program directed toward measuring multiplicity-spin conversions as a function of residual nucleus and excitation energy are discussed. Examples of partial fusion cross sections, gamma fold distributions and gamma spectra from three system being studied are shown. Prospects for future experiments with the spectrometer are described.

42548 (ANL-PHY—86-1, pp 635-646) **Incomplete fusion reactions induced by ^{12}C at 5.5-10 MeV/u.** Tserruya, I.; Steiner, V.; Fraenkel, Z.; Jacobs, P.; Kovar, D.G.; Henning, W.; Vineyard, M.F.; Glagola, B.G. (Weizmann Institute of Science, Rehovot, Israel). 1986. NTIS, PC A99/MF A01. File Number DE87010055. (CONF-860396—).

From Symposium on the many facets of heavy ion fusion reactions; Argonne, IL, USA (24 Mar 1986).

Evaporation residues following the interaction of ^{12}C with targets of ^{197}Au, ^{160}Gd, ^{120}Sn and ^{90}Zr have been measured in the energy range of E/sub lab/ = 5.5-10 MeV/u. The measurements were carried out using a large area (10 x 8 cm^2) detector capable of detecting very low energy (down to 1MeV) heavy ions (with mass up to 200). The complete fusion (CF) and incomplete fusion (ICF) events were identified by their time-of-flight. The experimental system allows precise determination of the cross sections of the CF and the ICF processes with a sensitivity to ICF processes below the percent level. The ICF processes were observed at all bombarding energies studied, even at the very lowest bombarding energies, slightly above the Coulomb barrier. The two processes have very different angular distribution, with the ICF angular distribution peaked at a significantly larger angle than the CF angular distribution.

42549 (ANL-PHY—86-1, pp 647-648) **Average neutron kinetic energies in the ^{120}Sn(^{28}Si,4n) fusion reaction.** Vivien, J.P.; Beck, F.A.; Bozek, E.; Byrski, T.; Gehringer, C.; Haas, B.; Merdinger, J.C.; Nourreddine, A.; Villard, M.M.; Hannachi, F.; Thibaud, J.P. (Centre de Recherches Nucleaires, Strasbourg, France). 1986. NTIS, PC A99/MF A01. File Number DE87010055. (CONF-860396—).

From Symposium on the many facets of heavy ion fusion reactions; Argonne, IL, USA (24 Mar 1986).

Average neutron energies of the 4n channel in the ^{28}Si + ^{120}Sn fusion reaction have been obtained by two methods. First, using various γ-ray techniques, the average total energy of the prompt γ cascades feeding the 10^+, 145 ns isomer in ^{144}Gd have been determined. This isomer was used to select the 4n exit channel. The average neutron kinetic energies <E/sub n/> γ deduced from these measurements are reported for different excitation energies E* of the compound nucleus. The kinetic energies exhibit a sharp dependence on excitation energy. The second method is a direct measurement, under the same conditions, of the average kinetic energy using time of flight techniques. A liquid scintillator NE213 was positionned at 0° and 70 cm from the target. The isomer was selected with the Cristal Castle, a 4π detector composed of 74 BaF_2 cristals. The average energies <E/sub n/>/sub m/ and the temperatures T deduced from the neutron energy spectra are also reported in the table. Except for the lowest excitation energy there is a striking difference between the values obtained via both methods. This may imply systematic errors in the determination of the average total energy of the γ cascades.

42550 (ANL-PHY—86-1, pp 655-662) **Partial fusion reaction studied by the spin spectrometer.** Yamada, H.; Sarantites, D.G.; Hamilton, J.H.; Maguir, C.F. (Univ. of Melbourne, Victoria, Australia). 1986. NTIS, PC A99/MF A01. File Number DE87010055. (CONF-860396—).

From Symposium on the many facets of heavy ion fusion reactions; Argonne, IL, USA (24 Mar 1986).

Spin spectrometer experiments were undertaken to study partial fusion (PF) reactions of ^{150}Sm(^{14}N,p(d,t)xn). The centroid of ell-fold (K) distributions was found to shift to higher as ejectile energy. The K-distribution spectra obtained by gating also with discrete γ-rays indicated two components. The narrower one seems to originate from the PF reaction. This could be the evidence of the angular momentum window from the PF reaction observed without interferences of the evaporations.

42551 **(CBPF-NF—005/86) States in ^{94}Zr from ^{94}Zr(d,d')^{94}Zr* at 15.5 Mev.** Frota-Pessoa, E.; Joffily, S. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1986. 24p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702663.

^{94} energy levels up to approx. 4.3 Mev excitation energy are studied in the ^{94}Zr(d,d')^{94}Zr* reaction. Deuterons had a bombarding energy of 15.5 MeV. The emergent deuterons were analysed by a magnetic spectrograph and the detector was nuclear emulsion. The resolution in energy was about 11 KeV. The distorted-wave analysis was used to determine the l transferred, the β^2/sub l/ and J/sup PI/ values for some ^{94}Zr excited states. These results are compared with previous ones. 32 levels of excitation energy in ^{94}Zr were found which did not appear in previous ^{94}Zr(d,d') reactions. 20 levels do not correspond to the ones.

42552 (GSI—87-10-Prepr.) **Fast dissipative collisions.** Petrovici, M.; Cusson, R.; Guarino, G.; Olmi, A.; Toeke, J.; Albinski, J.; Bock, R.; Gobbi, A.; Gralla, S.; Hildenbrand, K.D. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Institutul de Fizica si Inginerie Nucleara, Bucharest (Romania); Duke Univ., Durham, NC (USA); Istituto Nazionale di Fisica Nucleare, Bari (Italy); Istituto Nazionale di Fisica Nucleare, Florence (Italy); Rochester Univ., NY (USA). Nuclear Structure Research Lab.). Feb 1987. 66p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87751874.

At a bombarding energy of 14.7 MeV/u the charge, mass and angular distributions have been measured as a function of energy-loss for reaction products induced by /sup 98/Mo and /sup 92/Mo projectiles on targets of /sup 98/Mo, /sup 147/Sm, /sup 154/Sm and /sup 92/Mo, /sup 154/Sm, /sup 238/U, respectively. An analysis of the product distributions shows the presence of a non-equilibrium sharing of the excitation energy, an exponential growth of the charge and mass variances, a complete N/Z-equilibration and a large yield of non-binary complex fragments. Monte Carlo simulations are found to be an indispensable tool of the analysis.

42553 **Level structure of /sub 68//sup 149/Er/sub 81/ and high-spin isomerism in proton-rich N=81, 82, 83 nuclei.** Broda, R.; Daly, P.J.; McNeill, J.; Janssens, R.V.F.; Radford, D.C. (Purdue Univ., Lafayette, IN, USA. Dept. of Chemistry; Argonne National Lab., IL, USA. Physics Div.). *Zeitschrift fuer Physik A: Atomic Nuclei;* **327**: No. 4, 403-408(Aug 1987). Contract AC02-76ER01672;W-31-109-ENG-38.

The level structure of the N=81 nucleus /sup 149/Er has been studied by γ-ray spectroscopy following the reaction /sup 92/Mo+255 MeV /sup 60/Ni. Yrast levels in /sup 149/Er are established up to ≅ 3.3 MeV, including 0.61 and 4.8 μs isometric states. Most of the observed levels are interpreted as seniority-three states arising from the coupling of s/sub 1/2/, d/sub 3/2/ and h/sub 11/2/ neutron holes with πh/sup n//sub 11/2/. Isomers identified in the reaction /sup 96/Ru+255 MeV /sup 58/Ni are tentatively assigned to /sup 151/Yb. The B(E2) values of high-spin isomers in Z=66-70, N=81-83 nuclei are surveyed.

6518 Nuclear Properties And Reactions, A=150-189, Experimental

42554 (ANL-PHY—86-1, pp 413-426) **Studies of the $^{32}S + ^{182}W$ reaction.** Back, B.B.; Keller, J.G.; Worsham, A.; Glagola, B.G.; Henderson, D.; Kaufman, S.; Sanders, S.J.; Siemssen, R.; Videbaek, F.; Wilkins, B.D. 1986. NTIS, PC A99/MF A01. File Number DE87010055. (CONF-860396—).

From Symposium on the many facets of heavy ion fusion reactions; Argonne, IL, USA (24 Mar 1986).

Fission-like products from the reaction $^{32}S + ^{182}W$ were measured over the entire angular range from Theta = 10-170° and for bombarding energies of E/sub lab/ = 166, 177, 222, and 260 MeV using an array of eight Si detectors. From the measured energy and time-of-flight the product mass was determined event-by-event by performing the appropriate corrections for the plasma delay and pulse height defect associated with Si detectors. The mass, angular, and total kinetic energy distributions of fission-like fragments are obtained by assuming two-body kinematics. The angular distributions are more anisotropic than predicted by the standard fission theory. Furthermore, they observe an angular dependence of the fragment mass distributions, a feature which is incompatible with compound nucleus decay. Both of these observations indicate that a fraction of fission-like products originate from quasi-fission, a process in which a large degree of mass transfer occurs between the two interaction nuclei in a short time scale.

42555 (ANL-PHY—86-1, pp 629-634) **Deflection of non-equilibrium light particles by the nuclear mean field.** Tsang, M.B.; Ronningen, R.M.; Bertsch, G.; Chen, Z.; Chitwood, C.B.; Fields, D.J.; Gelbke, C.K.; Lynch, W.G.; Nayak, T.; Pochodzalla, J.; Shea, T. (Michigan State Univ., East Lansing). 1986. NTIS, PC A99/MF A01. File Number DE87010055. (CONF-860396—).

From Symposium on the many facets of heavy ion fusion reactions; Argonne, IL, USA (24 Mar 1986).

Since the collective motion in the nuclear mean field is damped by individual nucleon-nucleon collisions, the relative importance of positive and negative emission angles is sensitive to the interplay between mean field dynamics and two-body dissipation. These issues have been addressed experimentally by determining the sign of the average emission angle of non-equilibrium ight particles from the circular polarization of associated γ-rays emitted by the residual nucleus for ^{14}N induced reactions on ^{154}Sm at E/A = 20 and E/A = 35 MeV. For these mass-asymmetric systems, the light particle spectra are dominated by non-equilibrium processes. The experiment was performed at the National Superconducting Cyclotron Laboratory at Michigan State University.

6519 Nuclear Properties And Reactions, A=190-219, Experimental

42556 (ANL-PHY—86-1, pp 371-388) **Statistical aspects of highly excited and non-equilibrium nuclear systems.** Lynch, W.G. (Michigan State Univ., East Lansing). 1986. NTIS, PC A99/MF A01. File Number DE87010055. (CONF-860396—).

From Symposium on the many facets of heavy ion fusion reactions; Argonne, IL, USA (24 Mar 1986).

Source radii extracted from correlation functions for coincident light particles and emission temperature measurements from the relative populations of particle unstable states of ^{5}Li, ^{6}Li, and ^{8}Be nuclei are presented for ^{40}Ar induced reactions on ^{197}Au at E/A = 60 MeV and ^{14}N induced reactions on ^{197}Au at E/A = 35 MeV. Average emission temperatures of 4-5 MeV are obtained for both reactions. For ^{14}N induced reactions, both emission temperatures and source radii extracted from two particle correlation measurements depend significantly upon the kinetic energy of the detected particle unstable fragment. For ^{40}Ar induced reactions, the energy dependence of the emission temperatures is less pronounced. Results of emission temperature measurements from low energy γ-ray transitions are presented for ^{32}S induced reactions on Ag at E/A = 22.3 MeV. The gamma ray measurements are seen to be strongly influenced by sequential decay processes, thus these transitions cannot be used to determine the temperature of highly excited systems.

42557 (ANL-PHY—86-1, pp 621-628) **Coupled reaction channels analysis of reactions of ^{17}O on ^{208}Pb.** Thompson, I.J.; Fulton, B.R.; Lilley, J.S.; Banes, D.W.; Nagarajan, M.A. (Univ. of Bristol, England). 1986. NTIS, PC A99/MF A01. File Number DE87010055. (CONF-860396—).

From Symposium on the many facets of heavy ion fusion reactions; Argonne, IL, USA (24 Mar 1986).

The elastic scattering and single neutron transfer cross sections in the reaction of 78 MeV ^{17}O on ^{208}Pb are measured. A three body model, where the ^{17}O nucleus is treated as a weak coupling system of a valence neutron and an inert ^{16}O core, is used within the framework of the coupled reaction channel method. Good agreement between the theoretical predictions and the experimental data are obtained when multistep effects are included. The importance of using the core-core (^{16}O-^{208}Pb) potential at the appropriate energy in the weak coupling context is shown clearly in the analysis of the elastic scattering. It is shown that the effect of the neutron transfer channels is to cause a strong surface absorption thereby yielding large direct reaction cross sections. The valence neutron reaction channels do not influence the real part of the elastic potential. The prediction of the reaction cross section in the ^{17}O-^{208}Pb system is presented.

42558 (ANL-PHY—86-1, pp 649-654) **Interaction of O and N ions with ^{208}Pb and ^{209}Bi at sub-barrier energies.** Vulgaris, E.; Steadman, S.G.; Ledoux, R.J.; Grodzins, L. (Massachusetts Institute of Technology, Cambridge). 1986. NTIS, PC A99/MF A01. File Number DE87010055. (CONF-860396—).

From Symposium on the many facets of heavy ion fusion reactions; Argonne, IL, USA (24 Mar 1986).

The cross-section yields for various channels have been studied extensively for four reactions involving oxygen and nitrogen projectiles and ^{208}Pb and ^{209}Bi targets, at projectile energies from well below to well above the Coulomb barrier. The data on ^{15}N + ^{209}Bi are well fit by including the expected contributions of zero point fluctuations into the one-dimensional barrier penetrability formalism. The fusion cross sections and fission angular distributions for the other reactions cannot be accounted for by zero point motions alone. Data obtained in transfer reactions support the suggestion that inclusion of the coupling to transfer channels may satisfactorily account for the energy dependences of the fusion cross sections and the angular distribution of the induced-fission fragments.

42559 **(ZfK—605) Meson-exchange effets on 0/sup +/- O/sup -/ β-decay transitions in A = 206 nuclei.** Kirchbach, M. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). Oct 1986. 8p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702879.

It is shown that the renormalization of the weak-axial charge density due to the mesonic exchange effects leads to a reduction of the one-body shell-model log ft-values for the β-decays /sup 206/ Hg(0/sup +/) -> /sup 206/Tl(0/sup -/), and /sup 206/Tl(0/sup -/) -> /sup 206/Pb(0/sup +/) by about two units and gives a satisfactory agreement with experiment.

42560 **Determination of the absolute K through O conversion coefficients of the 80-keV M4 transition in /sup 193/Ir/ sup m/.** Lindner, M.; Gunnink, R.; Nagle, R.J. (Lawrence Livermore National Laboratory, Livermore, California 94550). *Physical Review* [*Section*] *C: Nuclear Physics;* **36**: No. 3, 1132-1137(Sep 1987). Contract W-7405-ENG-48.

We produced carrier-free, nearly isotopically pure /sup 193/ Ir/sup m/ from thermal-neutron irradiation of /sup 192/Os. From studies of the conversion-electron spectrum, the photon spectrum, and the absolute counting rates, we determined the absolute K, L1, L2, L3, M1, M3, M5, N, and O+P conversion coefficients for the first time. With possibly one exception, these values agree closely with theoretical calculations. The value for the energy of the unconverted gamma ray was found to be 80.22 +- 0.02 keV. The half-life for /sup 193/Ir/sup m/ determined by absolute electron counting in a proportional counter of 100% counting efficiency ($4\pi\beta$) was found to be 10.53 +- 0.04 d. We have determined the L_1 subshell fluorescence yield, ω_1, to be 0.120 +- 0.003 for iridium. Based upon our measurements of initial and final L subshell vacancies together with a best-fit literature value for ω_2, we have found a plausible value for the Coster-Kronig coefficient f/sub 12/ to be 0.091 +- 0.011.

42561 **Photon decay of giant resonances.** Bertrand, F.E.; Beene, J.R.; Halbert, M.L. (Oak Ridge National Lab., Oak Ridge, TN 37831). pp 326-346 of Nuclear spectroscopy and nuclear reactions. Ejiri, H.; Fukuda, T. Teaneck, NJ; World Scientific Pub. Co. (1984). (CONF-840312—). Contract AC05-84OR21400.

From Conference on the changing structure of the world oil industry; Guildford, UK (22 Mar 1984).

The authors have made measurements of the photon decay of the giant multipole resonances in /sup 208/Pb. The giant resonances were excited by inelastic scattering of 380 MeV /sup 17/O projectile and the photons were detected in the ORNL Spin Spectrometer. The results show a quadrupole resonance ground state gamma branch of 20% while only $\leqq$2% of the GQR decay proceeds through the 2.6 MeV, 3/sup -/ state. Nearly one half of the GQR decay through a 3/sup -/ state at 4.974 MeV. Photon decay from the dipole and monopole resonance and high spin resonances (4/sup +/,6/sup +/) are also observed.

6520 Nuclear Properties And Reactions, A=220 And Above, Experimental

42562 (ANL-PHY—86-1, pp 257-284) **Fusion with projectiles from carbon to argon at energies between 20A MeV and 60A MeV.** Galin, J. (GANIL, Caen, France). 1986. NTIS, PC A99/MF A01. File Number DE87010055. (CONF-860396—).

From Symposium on the many facets of heavy ion fusion reactions; Argonne, IL, USA (24 Mar 1986).

Fusion reactions are known to be the dominant reaction channel at low bombarding energies and can now be investigated with a large variety of projectiles at several tens of MeV per nucleon. The gross characteristics of the fusion process can be studied by measuring global quantities, such as the linear momentum transferred from projectile to target and the dissipated energy of the reaction. The strong correlation between these two quantities is demonstrated at moderate bombarding energies, with a Ne projectile on a U target. It is expected that light particle (charged or neutron) multiplicity measurements can be extended to this higher energy domain and be used to selectively filter these collisions, according to their degree of violence. A review of the linear momentum transfer is made, considering essentially heavy targets and two important parameters in the entrance channel: the projectile energy and its mass. Over a broad mass range, and for energies up to 30A MeV, the momentum transfer scales with the mass of the projectile. At 30A MeV, the most probable value of projectile momentum transferred to the fused system is 80%, and this represents roughly 180 MeV/c per projectile nucleon. At higher bombarding energies, the momentum distribution in the fused systems, as observed from binary fission events, seems to depend on the mass of the projectile. Further studies are still needed to understand this behavior. Finally, the decay of highly excited (E* similarly ordered 500-800 MeV) fused systems, with masses close to 270 amu, is studied from the characteristics of both fusion fragments and light charged particles. It is shown that thermal equilibrium is reached before fission, even for such high energy deposition. However, the decay sequence is sensitive to dynamical effects and does not depend only on available phase space.

42563 (ANL-PHY—86-1, pp 459-466) **Formation and decay of hot nuclei.** Cassagnou, Y.; Conjeaud, M.; Dayras, R.; Harar, S.; Legrain, R.; Mostefai, M.; Pollacco, E.C.; Volant, C.; Klotz-Engmann, G.; Oeschler, H. (Basse Energie CEN Saclay, Gif-sur-Yvette, France). 1986. NTIS, PC A99/MF A01. File Number DE87010055. (CONF-860396—).

From Symposium on the many facets of heavy ion fusion reactions; Argonne, IL, USA (24 Mar 1986).

The present investigation was carried out to determine the entrance channel conditions to form hot nuclei and to study their decay properties. Thorium 232 was bombarded with nitrogen 14, argon 40 and nickel 58 projectiles and uranium was bombarded with nitrogen 14 projectiles at energies from 31 to 44 MeV/u at the GANIL facility. Angular correlations, masses and velocities of the fission fragments were measured to determine linear momentum transfer and excitation functions. Scaling of momentum transfer with projectile mass and scaling of excitation energies with velocity and size of projectiles have been observed.

42564 **Differential range measurement of the interaction of /sup 238/U with 400 GeV protons.** Klingensmith, D.L.; Porile, N.T. (Department of Chemistry, Purdue University, West Lafayette, Indiana 47907). *Physical Review* [*Section*] *C: Nuclear Physics;* **36**: No. 3, 1051-1057(Sep 1987).

Energy spectra of products with A = 47—143 emitted at 90° to the beam in the interaction of /sup 238/U with 400 GeV protons were obtained from measured differential ranges. The products can be divided into two groups: those showing a single dominant energetic component and those with an additional low-energy component. The energetic component was fit with a thermal fragment emission model and is consistent with binary fission and, for the lightest products, with fragmentation. The low-energy component is consistent with a deep spallation mechanism.

6530 Nuclear Theory

REFER ALSO TO CITATION(S) 40541, 42337, 42374, 42378, 42452, 42515, 42557

42565 (ANL-PHY—86-1, pp 49-62) **Fusion: microscopic models and astrophysical aspects.** Koonin, S.E. (California Institute of Technology, Pasadena). 1986. NTIS, PC A99/MF A01. File Number DE87010055. (CONF-860396—).

From Symposium on the many facets of heavy ion fusion reactions; Argonne, IL, USA (24 Mar 1986).

Four topics in heavy ion fusion reactions are briefly discussed. Results from time-dependent Hartree-Fock calculations are shown and some possible improvements to them, eg. the inclusion of L-S coupling, are considered. Another model which is based on barrier penetration is then discussed and some experimental and theoretical work on the systematics of the oxygen-oxygen system is presented. The paper closes with a review of the application of heavy ion reactions to astrophysical problems in star burning.

42566 (ANL-PHY—86-1, pp 63-88) **Angular momentum limitations to fusion.** Lee, S.M.; Yokota, W.; Matsuse, T. (Univ. of Tsukuba, Ibaraki, Japan). 1986. NTIS, PC A99/MF A01. File Number DE87010055. (CONF-860396—).

From Symposium on the many facets of heavy ion fusion reactions; Argonne, IL, USA (24 Mar 1986).

A central problem of fission-like processes assigned to the various reaction mechanisms on the bases of experimental signatures (total kinetic energy, mass and angular distribution) in light and medium systems ($A \leqq 120$) is discussed and summarized. Assuming that all fission-like processes are fusion-fission, they are extensively analyzed in terms of the Extended Hauser-Feshbach (EHF) method with an appropriate parameter set, in which angular momentum limitations to fusion are calculated by using the Successive Critical Distance Model. The experimental data are reasonably well accounted for over a wide range of system and energy. Furthermore the observed symmetric and asymmetric mass distribution in fission-like process are well understood as being due to the shell effect of binding energy depending on the excitation energy of fission fragments.

42567 (ANL-PHY—86-1, pp 89-114) **Limitations of heavy element production.** Armbruster, P. (GSI Darmstadt, West Germany). 1986. NTIS, PC A99/MF A01. File Number DE87010055. (CONF-860396—).

From Symposium on the many facets of heavy ion fusion reactions; Argonne, IL, USA (24 Mar 1986).

Several experiments on superheavy element production and decay performed at the UNILAC accelerator are reviewed. Measured values of alpha energies and alpha decay and fission halflives are used to establish trends for these quantities and comparisons with theoretical predictions of mass excesses, shell corrections and fission barriers are made. Limits to heavy element production are discussed and the outlook for the production of elements heavier than element 109 is considered.

42568 (ANL-PHY—86-1, pp 115-134) **Quasi-fission as a competing reaction between deep inelastic and compound-fission.** Albinska, M.; Dakowski, M.; Gobbi, A.; Shen, W.Q. (Gesellschaft fuer Schwerionenforschung, Darmstadt, West Germany). 1986. NTIS, PC A99/MF A01. File Number DE87010055. (CONF-860396—).

From Symposium on the many facets of heavy ion fusion reactions; Argonne, IL, USA (24 Mar 1986).

Using a simple simulation calculation as an interface between experiment and theory, a more realistic and detailed comparison with the microscopic calculations becomes possible. Of particular interest are mass-drift and deflection functions. The overall agreement is rather good: the largest discrepancy is seen for the deflection functions, where the microscopic calculations predict, for the peripheral trajectories, a rather abrupt change toward negative angles; the simulation shows a less abrupt change. On the basis of deflection and mass-drift function derived from the simulation, the authors can also obtain the mass relaxation as a function of time.

42569 (ANL-PHY—86-1, pp 135-154) **Effect of dissipation on dynamical fusion thresholds.** Sierk, A.J. (Los Alamos National Lab., NM). 1986. NTIS, PC A99/MF A01. File Number DE87010055. (CONF-860396—).

From Symposium on the many facets of heavy ion fusion reactions; Argonne, IL, USA (24 Mar 1986).

The existence of dynamical thresholds to fusion in heavy nuclei ($A \geqq 200$) due to the nature of the potential-energy surface is shown. These thresholds exist even in the absence of dissipative forces, due to the coupling between the various collective deformation degrees of freedom. Using a macroscopic model of nuclear shape dynamics, the author shows how three different suggested dissipation mechanisms increase by varying amounts the excitation energy over the one-dimensional barrier required to cause compound-nucleus formation. The recently introduced surface-plus-window dissipation may give a reasonable representation of experimental data on fusion thresholds, in addition to properly describing fission-fragment kinetic energies and isoscalar giant multipole widths. Scaling of threshold results to asymmetric systems is discussed.

42570 (ANL-PHY—86-1, pp 155-174) **Spin distributions in near-barrier and sub-barrier fusion reactions.** Vandenbosch, R. (Univ. of Washington, Seattle). 1986. NTIS, PC A99/MF A01. File Number DE87010055. (CONF-860396—).

From Symposium on the many facets of heavy ion fusion reactions; Argonne, IL, USA (24 Mar 1986).

Determination of the spin distribution in heavy ion fusion reactions provides a test of the understanding of the factors contributing to sub-barrier fusion and models used to describe the fusion cross section as a function of energy must also explain the compound nucleus spin distribution. Models of sub-barrier fusion are briefly described. Experimental results on spin distributions are then reviewed and comparisons with models are discussed.

42571 (ANL-PHY—86-1, pp 195-218) **Complex fragment emission from hot compound nuclei.** Moretto, L.G. (Lawrence Berkeley Lab., Berkeley, CA). 1986. NTIS, PC A99/MF A01. File Number DE87010055. (CONF-860396—). Contract AC03-76SF00098.

From Symposium on the many facets of heavy ion fusion reactions; Argonne, IL, USA (24 Mar 1986).

The experimental evidence for compound nucleus emission of complex fragments at low energies is used to interpret the emission of the same fragments at higher energies. The resulting experimental picture is that of highly excited compound nuclei formed in incomplete fusion processes which decay statistically. In particular complex fragments appear to be produced mostly through compound nucleus decay. In appendix a geometric-kinematic theory for incomplete fusion and the associated momentum transfer is outlined.

42572 (ANL-PHY—86-1, pp 237-256) **Linear momentum transfer in projectile-nucleus collisions.** Viola, V.E.; Kwiatkowski, K. (Indiana Univ., Bloomington). 1986. NTIS, PC A99/MF A01. File Number DE87010055. (CONF-860396—). Contract AC02-81ER40007.

From Symposium on the many facets of heavy ion fusion reactions; Argonne, IL, USA (24 Mar 1986).

One of the basic observables that must be successfully described by a theory of projectile-nucleus collisions is the distribution of linear momentum transferred form projectile to target. The present experimental data base for this quantity is reviewed and compared with various theories. The systematics of linear momentum transfer as a function projectile type and target mass for low to intermediate energies is summarized.

42573 (ANL-PHY—86-1, pp 285-302) **Semi-classical precompound decay models for heavy ion reactions of 10-100 MeV/nucleon.** Blann, M. (Lawrence Livermore National Lab., CA). 1986. NTIS, PC A99/MF A01. File Number DE87010055. (CONF-860396—).

From Symposium on the many facets of heavy ion fusion reactions; Argonne, IL, USA (24 Mar 1986).

Two semiclassical approaches to describing precompound-nucleus emission in heavy ion reactions, the hybrid and the Boltzmann master equation, are described. The physical concepts involved in the models are discussed and their numerical formulations are summarized. Model calculations are compared with experimental data for nuclear fragment and neutron spectra and for subthreshold pion production.

42574 (ANL-PHY—86-1, pp 303-324) **Transition to the fragmentation region.** Homeyer, H. (Hahn-Meitner Institut Berlin, West Germany). 1986. NTIS, PC A99/MF A01. File Number DE87010055. (CONF-860396—).

From Symposium on the many facets of heavy ion fusion reactions; Argonne, IL, USA (24 Mar 1986).

In order to address the question of the origin of nuclear fragments in heavy ion fusion reactions the author compiles and examines the data for the neon 20 - gold 197 system at bombarding energies between 7.5 and 20 MeV/n. Both inclusive and exclusive data are considered. Cross sections, excitation functions, neutron multiplicity, charge distributions, isotopic distributions and momentum widths are presented and discussed.

42575 (ANL-PHY—86-1, pp 343-370) **Fragmentation of classical systems.** Schlagel, T.J.; Pandharipande, V.R. (Univ. of Illinois, Urbana). 1986. NTIS, PC A99/MF A01. File Number DE87010055. (CONF-860396—).

From Symposium on the many facets of heavy ion fusion reactions; Argonne, IL, USA (24 Mar 1986).

The authors report studies of fragmentation of classical charged hot drops containing 216 particles, and of fragmentation in collisions of cold 16-particle balls with 200-particle balls and two 108-particle balls, with the molecular dynamics method. The dynamics of the fragmentation process is studied. At lower energies it is fission-like, while at higher energies it is dominated by the liquid-gas phase transition. In collisions between the 108-particle balls most of the beam energy appears to thermalize; the mass yields from these collisions are similar to those obtained in the fragmentation of a hot liquid drop. In the 16 + 200 collisions, however, there is a significant amount of pre-equilibrium emission, and only a small fraction of the beam energy is thermalized.

42576 (ANL-PHY—86-1, pp 389-396) **Heavy-ion fusion reactions in perspective.** Randrup, J. (Lawrence Berkeley Lab., CA). 1986. NTIS, PC A99/MF A01. File Number DE87010055. (CONF-860396—). Contract AC03-76SF00098.

From Symposium on the many facets of heavy ion fusion reactions; Argonne, IL, USA (24 Mar 1986).

In this summary talk for the symposium the author comments in a general way on various aspects of heavy ion fusion reactions. Among the topics discussed are: sub-barrier fusion, spin distribution of fusion products, quasi-fission reactions, complex-fragment emission, incomplete momentum transfer, preequilibrium emission and molecular dynamics. In his closing remarks he alludes to several other important nuclear reaction issues that were not specifically addressed at the conference, e.g., chaotic nucleonic motion and single-particle degrees of freedom.

42577 (ANL-PHY—86-1, pp 397-406) **Summary talk.** Siemssen, R.H. (Kernfysisch Versneller Instituut, Groningen, Netherlands). 1986. NTIS, PC A99/MF A01. File Number DE87010055. (CONF-860396—).

From Symposium on the many facets of heavy ion fusion reactions; Argonne, IL, USA (24 Mar 1986).

In this summary talk for the symposium the author discusses selected topics of particular interest to him. Among the topics discussed are sub- and near-barrier fusion, entrance channel effects, limitations to fusion and folding angles. Specific papers given at the conference are referenced and discussed.

42578 (ANL-PHY—86-1, pp 407-412) **Transport description of intermediate processes in heavy ion collisions.** Ayik, S.; Shivakumar, B.; Shapira, D. (Tennessee Technological Univ., Cookeville). 1986. NTIS, PC A99/MF A01. File Number DE87010055. (CONF-860396—).

From Symposium on the many facets of heavy ion fusion reactions; Argonne, IL, USA (24 Mar 1986).

An extension of the diffusion model is proposed to explain intermediate processes and compound nucleus formation in heavy ion reactions. The model is based on the idea of the formation of a dinuclear molecular complex and its subsequent decay by fragmentation. This complex evolves through exchange of nucleon to different dinuclear configurations. At each stage there is a finite probability of fragmentation into outgoing channels through thermal penetration of the barrier. The doorway states that do not fragment relax into a compound nuclear configuration and appear in the fusion yield. The model has been successfully applied to the Si - C system.

42579 (ANL-PHY—86-1, pp 477-486) **Simplified coupled-channel code for calculation of fusion cross sections in heavy ion reactions.** Dasso, C.H.; Landowne, S. (Niels Bohr Institute, Copenhagen, Denmark). 1986. NTIS, PC A99/MF A01. File Number DE87010055. (CONF-860396—).

From Symposium on the many facets of heavy ion fusion reactions; Argonne, IL, USA (24 Mar 1986).

This program calculates total and partial fusion cross sections at near-barrier energies, allowing for the couplings to collective surface excitations and additional channels. The matrix diagonalization method proposed in Ref. [1] is applied, as it was done in [2] for fusion excitation functions and in [3] for spin distributions. The empirical nuclear potential given in [4] is used with an adjustable overall strength. In this version of the code there is no cut-off for the fusion of high partial waves due to fission instability.

42580 (ANL-PHY—86-1, pp 589-596) **Fusion time by using the elastic model.** Scalia, A. (Universita di Catania, Italy). 1986. NTIS, PC A99/MF A01. File Number DE87010055. (CONF-860396—).

From Symposium on the many facets of heavy ion fusion reactions; Argonne, IL, USA (24 Mar 1986).

A review of the previously proposed elastic model is given. The author then shows how a time interval for heavy ion fusion reactions can be computed from the model. Time intervals for several different systems are calculated and shown to be a function of Q-value. Based on this correlation the author argues that the calculated time intervals are the interaction times for the reactions.

42581 (ANL-PHY—86-1, pp 597-604) **Formation of a dinuclear complex in collisions between light nuclei and entrance channel limitations to fusion.** Shapira, D.; Shivakumar, B.; Ayik, S.; Harmon, B.A. (Oak Ridge National Lab., TN). 1986. NTIS, PC A99/MF A01. File Number DE87010055. (CONF-860396—). Contract AC05-84OR21400.

From Symposium on the many facets of heavy ion fusion reactions; Argonne, IL, USA (24 Mar 1986).

A model for fusion of light nuclei has been proposed recently wherein fusion progresses through nucleus-nucleus capture via a dinuclear stage which acts as a doorway to fusion. While this model accounts for the fusion cross sections, it makes no attempt at predicting observables associated with the non-fusion part of the captured flux. A study of products from the decay of the dinuclear complex into non-fusion channels can provide a stringent test for such a model. In this contribution a model which addresses both the binary decay and the fusion of a dinuclear complex formed in the collision is described and model predictions are compared with data. Accompanying contributions discuss the formalism which is used to describe the evolution of the dinuclear complex and present new data which provide information that helps justify the approximations made in applying this model.

42582 (ANL-PHY—86-1, pp 613-620) **Coupled channel calculations simplified: multi-phonon and isotope effects in sub-barrier fusion reactions.** Takigawa, N.; Ikeda, K. (Tohoku Univ., Sendai, Japan). 1986. NTIS, PC A99/MF A01. File Number DE87010055. (CONF-860396—).

From Symposium on the many facets of heavy ion fusion reactions; Argonne, IL, USA (24 Mar 1986).

In the first part of the paper the authors derive simplified coupled channel equations which take into account angular momentum. In the second part of the paper the equations are applied to the heavy ion systems nickel 58 + nickel 58, germanium 74 + ger-

manium 74 and sulfur 36 + several molybdenum isotopes at subbarrier energies. Calculated cross sections and excitation functions are compared with experimental results under various assumptions.

42583 **(BNL—39914) Physics at RHIC [Relativistic Heavy Ion Collider]: What do we want to know, and what do we want to measure?.** Satz, H. (Brookhaven National Lab., Upton, NY (USA); Bielefeld Univ. (Germany, F.R.). Fakultaet fuer Physik). 1987. Contract AC02-76CH00016. 6p. (CONF-870543—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE87011289.

From 2. workshop on experiments and detectors for relativistic heavy ion collider; Berkeley, CA, USA (25 May 1987).

The main features of nuclear collisions that are to be measured at the Relativistic Heavy Ion Collider (RHIC) are briefly surveyed. The main questions to be addressed in studying such collisions are stated, along with some possible experimental ways of addressing these questions. The features of relativistic heavy ion collisions discussed are: macroscopic size and collective behavior, energy density, thermal equilibrium, initial temperature, chemical equilibrium, color deconfinement, and plasma expansion and hadronization. (LEW)

42584 **(BNL—39978) Testing the Brink hypothesis experimentally by neutron capture.** Kopecky, J.; Chrien, R.E. (Brookhaven National Lab., Upton, NY (USA); Netherlands Energy Research Foundation, Petten). 1987. Contract AC02-76CH00016. 4p. (CONF-8708101—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012492.

From 6. international symposium on capture gamma-ray spectroscopy; Leuven, Belgium (31 Aug 1987).

The energy distribution of E1 reduced strength is consistent with an interpretation of the energy and nuclear temperature dependent damping width in the Lorentzian extrapolation.

42585 **(CONF-870448—1) Can 250^{+} fusions per muon be achieved?.** Jones, S.E. (Brigham Young Univ., Provo, UT (USA). Dept. of Physics and Astronomy). 1987. Contract FG02-85ER13449. 17p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87010472.

From Workshop on muon-catalyzed fusion and fusion with polarized nuclei; Erice, Italy (3 Apr 1987).

Nuclear fusion of hydrogen isotopes can be induced by negative muons (μ) in reactions such as: $\mu^- + d + t \rightarrow \alpha + n + \mu^-$. This reaction is analagous to the nuclear fusion reaction achieved in stars in which hydrogen isotopes (such as deuterium, d, and tritium, t) at very high temperatures first penetrate the Coulomb repulsive barrier and then fuse together to produce an alpha particle (α) and a neutron (n), releasing energy. The muon in general reappears after inducing fusion so that the reaction can be repeated many (N) times. Thus, the muon may serve as an effective catalyst for nuclear fusion. Muon-catalozed fusion is unique in that it proceeds rapidly in deuterium-tritium mixtures at relatively cold temperatures, e.g., room temperature. The need for plasma temperatures to initiate fusion is overcome by the presence of the muon.

42586 **(CONF-8703145—1) What lies beyond the mean-field?.** Strayer, M.R. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 42p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87010905.

From Workshop on heavy-ion reaction dynamics studies with large counter arrays; Toronto, Canada (27 Mar 1987).

This paper discusses statistical theories that attempt to understand the physics of heavy ion collisions at excitation energies near 15 MeV. These statistical models of fragmentation try to extract the underlying collective nucleus-nucleus dynamics. The author discusses spallation percolation mechanisms, canonical and microcanonical ensembles, the Hanbury-Brown Twiss correlation measurements, and the nuclear equation of state at high densities. 17 refs., 29 figs.

42587 **(CONF-8706113—4) Lepton production in ultra-relativistic ion-ion collisions.** Bottcher, C.; Strayer, M.R. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012247.

From 6. Adriatic international conference on nuclear physics; Dubrovnik, Yugoslavia (15 Jun 1987).

This paper addresses the production of heavy lepton pairs out of the vacuum using nonperturbative methods. The formal details of the method result in a simple picture, in which the propagation of the vacuum is obtained by solving the time-dependent Dirac equation in the presence of the electromagnetic fields of the colliding nuclei. In the current work, a simple model is discussed, in detail, which production cross sections are a function of the transverse momentum and rapidity. 10 refs., 4 figs.

42588 **(DOE/ER/40286—1) Configuration space Faddeev calculations: Progress report for period 1 January 1986-31 December 1986.** Payne, G.L.; Klink, W.H.; Polyzou, W.N. (Iowa Univ., Iowa City (USA). Dept. of Physics and Astronomy). Jan 1987. Contract FG02-86ER40286. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009656.

The detailed study of few-body nuclear systems provides a powerful tool to identify the relevant degrees of freedom in the nucleus. For these systems one can perform detailed and accurate numerical calculations which can be used to study the interactions between the various degrees of freedom. We have used these systems to investigate the size of the relativistic effects, the role of meson exchange currents, and the importance of the quark degrees of freedom in the nuclear system. New computational tools have been developed to treat relativistic operators. The effects of the Coulomb polarization potential on the low-energy scattering parameters have been investigated, and the effects of the Coulomb interaction on charge symmetry breaking have been studied. We have continued our project to find representations for multiparticle scattering amplitudes which satisfy certain physical properties. Finally, we have extended our work on the realization of the irreducible representations of compact groups as spaces of polynomials. These realizations can then be used in a symbolic manipulation prcgram to generate Clebsch-Gordan and Racah coefficients for groups important in nuclear physics applications. 37 refs.

42589 **(EFI—837(64)-85) Question of limiting fragmentation regime of nuclei.** Egiyan, K.Sh. (Erevanskij Fizicheskij Inst. (USSR)). 1985. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702688.

A question on reaching the regime of limiting fragmentation of nuclei as a function of initial energy is discussed. It is shown that if making use of the correlation length hypothesis, then one can obtain the expression of critical energy as a function of mass of the effective target and investigated process. Conclusions are made, whose validity can be checked up experimentally.

42590 **(FEI—1779) CCA-84 program: calculation of cross sections of particle inelastic scattering on nuclei by the coupled channel method. Equation system solution.** Titarenko, N.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1986. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702715.

The practical schemes of connected differential equation system numerical solution realized in CCA-84 program for computer calculation of cross sections of particle inelastic scattering on nuclei by the coupled channel method are presented. Algorithm of precise direct method for boundary-value multichannel problem numeric solution for connected equation systems with the account of open and closed scattering channels is given. The scheme of approximated iterative way to solve these equations is also described. Advantages and disadvantages of realized algorithms, multichannel boundary-value problem peculiarities, ways of iterative method convergence acceleration are discussed. 9 references, 2 tables.

42591 (INDC(BUL)—12, pp 3-9) **Mean resonance parameter testing by transmission experiments.** Janeva, N.B.; Koyumdjieva, N.T.; Mateeva, A.S.; Toshkov, S.A.; Ukraintzev, V.F.; Vankov, A.A. Feb 1987. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702592.

In Research on neutron resonance parameters of fissile nuclei.

An improved method for group averaged constants evaluation has been developed, including as a first step the analysis of the measured shielded cross sections. The experimental data on the transmission and self indication functions are used to obtain the best values of the average resonance parameters of ^{235}U and ^{239}Pu. The corresponding calculated group constants of ^{239}Pu, ^{240}Pu and ^{242}Pu are compared with the evaluation. 7 references, 2 figures, 2 tables.

42592 (INDC(BUL)—12, pp 17-22) **Evaluation of the group constants for ^{241}Pu in the unresolved resonance region. Progress report on Research Contract No. 4237/RB.** Georgiev, G.; Savova, N.; Tchikov, N.; Toshkov, S; Janeva, N. (Institute za Yadrena Izsledvaniya i Yadrena Energetika, Sofia, Bulgaria). Feb 1987. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702592.

In Research on neutron resonance parameters of fissile nuclei.

An evaluation of the ^{241}Pu group constants in the region 100 ev-30 KeV was performed taking into account the multilevel interference which has a significant contribution in the region of overlapping resonances. The energy averaged values of ^{241}Pu total, radiative, fission and elastic scattering cross sections at temperatures 900 deg. and 2100 deg. K are given. 9 references, 4 tables.

42593 **(INDC(BUL)—12) Research on neutron resonance parameters of fissile nuclei.** (International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee). Feb 1987. 22p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702592.

The document includes three reports on the neutron resonance parameters of fissile nuclei performed at the Institute for Nuclear Research and Nuclear Energy of Sofia (Bulgaria) and the Institute of Physics and Power Engineering of Obninsk (USSR) within the Co-ordinated Research Programme on Validation and Benchmark Testing of Actinide Nuclear Data supported by the IAEA. A separate abstract was prepared for each of these reports.

42594 (INDC(BUL)—12, pp 11-15) **Multilevel parametrization of fissile nuclei resonance cross sections.** Lukyanov, A.A.; Kolesov, V.V.; Janeva, N. (Institute za Yadrena Izsledvaniya i Yadrena Energetika, Sofia, Bulgaria). Feb 1987. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702592.

In Research on neutron resonance parameters of fissile nuclei.

Because the resonance interference has an important influence on the resonance structure of neutron cross sections energy dependence at lowest energies, multilevel scheme of the cross section parametrization which take into account the resonance interference is used for the description with the same provisions in the regions of the interferential maximum and minimum of the resonance cross sections of the fissile nuclei. 7 references.

42595 **(INDC(IND)—038/L) Neutron radiative capture cross section of ^{232}Th in the energy range 0.1 to 1.2 MeV.** Jain, H.M.; Kailas, S. (International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee). Mar 1987. 23p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702755.

Recently reported neutron radiative capture cross section of Th-232 measurements in the energy range 0.1 to 1.2 MeV are compared with the calculations based on the statistical model Hauser-Feshbach theory using the spherical optical model transmission coefficients and simple Fermi gas level density formula. The calculations are in good agreement with the recent experimental data, reproducing both the absolute magnitude and the shape exhibited by the excitation function. The results of this comparative study can be used for improving the evaluation of the neutron radiative capture cross section of Th-232. 16 references, 4 figures, 3 tables.

42596 **(INIS-BR—665) Rainbow and Fresnel diffraction effects in the heavy ion scattering.** Salvadori, M.C.B.S. (Sao Paulo Univ. (Brazil). Inst. de Fisica). 1984. 109p. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. File Number DE87702773.

A detailed theoretical analysis of the heavy-ion elastic scattering differential cross section, using the uniform semiclassical approximation of Berry in the sharp cut-off limit is presented. A decomposition of the cross section into four physically well-defined components is used in the analysis. The aim of the analysis is to explore the possibility of distinguishing at the cross-section level, between a pure rainbow or Fresnel diffraction nature of the heavy-ion elastic scattering at above-barrier energies and not too large angles.

42597 **(INIS-mf—10883) Inelastic excitation and nucleon optical potential.** Mughrabi, B.A. (Atomic Energy Commission, Damascus (Syria)). 1986. 28p. (In Arabic). NTIS (US Sales Only), PC A03/MF A01. File Number DE87702783.

The nucleon elastic scattering from targets of ^{40}Ca and ^{208}Pb has been studied in the presence of inelastic excitation to a fairly realistic set of levels. A method of averaging over the 1-dependence of the trivially equivalent local potentials has been suggested so as to obtain smooth, surface-peaked potentials which yield cross sections in good agreement with exact results in the forward hemisphere. Only slightly poorer agreement is obtained with potentials from simple, analytical formulae derived from the plane wave approximation. Approximate and exact inelastic cross sections have also been briefly compared.

42598 **(INS—576) Static electromagnetic properties of giant resonances.** Koo, W.K. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Mar 1986. 18p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702602.

Static electric monopole and quadrupole matrix elements, which are related to the mean square radius and quadrupole moment respectively, are derived for giant resonances of arbitrary multipolarity. The results furnish information on the size and shape of the nucleus in the excited giant states.

42599 **(IPNO-TH—86-13) Closure approximation to the absorptive potential in heavy ion scattering.** Vinh Mau, N. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). Feb 1986. 28p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87751828.

We propose a simple model which is based on the Feshbach's theory of optical potential. The use of closure relation in both nuclei implies that we impicitly include all possible channels, in particular inelastic scatteirng and one nucleon transfer processes. The local absorptive potential is calculated at large distances and its energy dependence is studied. The results are compared to other theoretical works and to phenomenological potentials.

42600 (JINR—D-10-11-84-818, pp 113-122) **Numerical methods for solving quantum problem of several bodies and their application in nuclear physics.** Kostomarov, D.P.; Kukulin, V.I. (Moskovskij Gosudarstvennyj Univ., USSR). 1985. (In Russian). NTIS (US Sales Only), PC A16/MF A01. File Number DE87780164. (CONF-8309402—).

From 5. international meeting on problems of mathematical simulation, programming, and mathematical methods for solving the physical problems; Dubna, USSR (20 Sep 1983).

A review of numerical methods for solving quantum many-body problems is given. Their application in studying light nuclei is considered. The bases of the methods are the variational and iterative approaches in combination with the orthogonal designing technique. It permits to overcome successfully the difficulty of calculation associated with very high dimensionality of such problems. All the methods are realized in programs for the BESM-6 and ES-1040 computers and they have proved high efficiency. The calculation time for one version is 2-5 min. The important advantage of the methods is a convenient semianalytical form of representation of a required wave function that simplifies calculation of physical parameters of the system under consideration. On the basis of the described methods the detailed calculations of the structure of different light nuclei are performed within the frames of models of several particles with the most complete description of all types of interactions between them. 14 refs.

42601 (JINR—D-10-11-84-818, pp 184-191) **Calculation of realistic densities of multiparticle-multihole nuclear states.** Tikhonov, A.N.; Galkin, V.Ya.; Ishkhanov, B.S.; Kanzyuba, V.G.; Orlik, S.I.; Orlin, V.N. (Moskovskij Gosudarstvennyj Univ., USSR). 1985. (In Russian). NTIS (US Sales Only), PC A16/MF A01. File Number DE87780164. (CONF-8309402—).

From 5. international meeting on problems of mathematical simulation, programming, and mathematical methods for solving the physical problems; Dubna, USSR (20 Sep 1983).

The method for calculating the densities of the np-kh nucleus states with the fixed quantum numbers J, π, T based on direct exhaustion of nucleon positions on the nucleus one-particle levels is described. The effects of short-range nucleon correlations (the pairing energy of nucleons of arbitrary type) are estimated. The algorithm for calculating realistic densities of multiparticle-multihole nucleus states is described. The realistic densities of the /sup 28/Si and /sup 32/S np-kh states are calculated. The photoabsorption cross sections and photoproton spectra for /sup 28/Si and /sup 32/S are found. It is shown that the use of the calculated realistic densities permit to explain the main features of the giant dipole resonance decay in the /sup 28/Si and /sup 32/S nuclei. 9 refs.

42602 (JINR—D-10-11-84-818, pp 353-354) **Program of neutron cross section simulation for transactinium nuclei in the region of unresolved resonances.** Nefed'eva, L.S.; Ukraintsev, V.F.; Yaneva, N. 1985. (In Russian). NTIS (US Sales Only), PC A16/MF A01. File Number DE87780164. (CONF-8309402—).

From 5. international meeting on problems of mathematical simulation, programming, and mathematical methods for solving the physical problems; Dubna, USSR (20 Sep 1983).

The problem of neutron cross section simulation for transactinium nuclei in the region of unresolved resonances is discussed. A model developed on the basis of the conclusions of the R-matrix theory of nuclear reactions in the Reich-Moore approximation is used in the calculations. The total cross section, fission cross section and elastic scattering cross section are determined in terms of the elements of the S collision matrix. On the basis of the Monte Carlo method the algorithm for using the distribution function of cross section probability density and comparing with the experimental data is developed. A set of the MNCARL programs for calculating transmissions, cross section self-indications, their momenta and average resonance parameters is developed. 2 refs.

42603 (JINR-E—86-449) **Impact parameter dependence of the specific entropy and the light particle yield in relativistic heavy ion collisions.** Gudima, K.K.; Roepke, G.; Schulz, H.; Toneev, V.D. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1986. 11p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702825.

The connection between the fragment yield and the associated specific entropy of particles produced in the course of a relativistic heavy ion collision is studied within the cascade approach. The essential impact parameter dependence of the fragment yield indicates that the specific entropy increases with impact parameter and that the critical density of the system decay is the larger the more central the collision process is. The results show that the thermodynamical equilibrium limit for the entropy production is not reached for such heavy systems as Nb+Nb at 400 MeV/nucleon and that the finite size effects and the dynamical freeze-out process are dominant factors in determining the cluster yield. 17 references, 2 figures.

42604 (JINR-R—4-86-273) **Energy density functional within the local-scale transformation method.** Petkov, I.Zh.; Stoitsov, M.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1986. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702830.

A local density formulation of the local-scale transformation method is given. The obtained kinetic energy density consists of two terms: the so-called Weizsacker correction term and the Thomas-Fermi like kinetic energy density term. The latter is an exact expression for an infinite system. The problem of the gradient corrections to the kinetic energy density is considered which appears as a result of introducing of v^2/c^2-relativistic corrections. It is shown that the Hartree-Fock approximation becomes ineffective for describing the 1s-shell nuclei. Therefore the methods going beyond the Hartree-Fock one should be used in these cases.

42605 (JINR-R—4-86-444) **Meson exchange currents and magnetic form factor of the deuteron.** Burov, V.V.; Dostovalov, V.N.; Sus'kov, S.Eh. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1986. 4p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702832.

The influence of meson exchange currents (MEC) on the deuteron magnetic form factor is studied. It is shown that the MEC contribution depends strongly on meson-nucleon form factors. An agreement is obtained for the structure function $B(q^2)$ in the whole region of measured transfer momentum $q^2 < 28$ fm^{-2} in choosing meson-nucleon form factors by the rules of quantum chromodynamics. A considerable decrease in the deuteron magnetic form factor with the MEC included in the momentum transfer region $q^2 > 50$ fm^{-2} is predicted. 9 references, 2 figures.

42606 (JINR-R—7-86-306) **Angular distribution of high energy gamma-quanta emitted in heavy ion reactions.** Kugler, A.; Mikhajlova, T.I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1986. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702833.

Angular distribution of high-energy γ-rays emitted from the compound nuclear states formed in the heavy ion collisions is modelled. Assumption of the statistical nature of the γ-ray emission and up-to-data theoretical models describing the influence of nuclear rotation on the charcteristics of the giant dipole resonance (GDR) are used. It is shown that the influence of rotation of the GDR energy may be found studying the anisotropy of high-energy γ-quanta as a function of their energy. The calculation is made for the $^{40}Ar + ^{159}Tb$ reaction leading to the ^{199}Bi compound nucleus. 13 references, 8 figures.

42607 (LA-UR—87-2037) **Recent results in the theory of the three-nucleon systems.** Friar, J.L. (Los Alamos National Lab., NM (USA)). Jun 1987. Contract W-7405-ENG-36. 16p. (CONF-8706149—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011770.

From International conference on the theory of few body and quark-hadronic systems; Dubna, USSR (16 Jun 1987).

This paper concentrates on calculational results obtained by the Los Alamos-Iowa Faddeev group and on related calculations. Most of the interest of this group has centered on the Helium 3 and Hydrogen 3 ground states, including the effects of the Coulomb interactions between the two protons in Helium 3. Recent progress in treating the alpha particle is reported and zero energy n-d and p-d scattering and an improved understanding of the scattering lengths for these systems are also discussed. Simple physical pictures for these results are presented where possible. 54 refs., 9 figs. (DWL)

42608 (LBL—23415) **Microcanonical simulation of nuclear multifragmentation.** Randrup, J.; Koonin, S.E. (Lawrence Berkeley Lab., CA (USA); California Inst. of Tech., Pasadena (USA). W.K. Kellogg Radiation Lab.). 16 Apr 1987. Contract AC03-76SF00098. 19p. (CONF-870410—34). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010259.

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

We discuss the formal basis for the theoretical treatment of nuclear multifragmentation within a microcanonical framework. The important role played by highly excited nuclear states and the interfragment forces is illustrated. The requirement of detailed balance is especially discussed and illustrated for the fission-fusion Metropolis moves in configuration space. 13 refs., 2 figs.

42609 (SLAC-PUB—4342) Hadronic and nuclear phenomena in quantum chromodynamics. Brodsky, S.J. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Jun 1987. Contract AC03-76SF00515. 42p. (CONF-870282—2). NTIS, PC A03. File Number DE87012318.

From 8. summer school of nuclear and particle physics; Launceston, Australia (2 Feb 1987).

Many of the key issues in understanding quantum chromodynamics involves processes at intermediate energies. We discuss a range of hadronic and nuclear phenomena - exclusive processes, color transparency, hidden color degrees of freedom in nuclei, reduced nuclear amplitudes, jet coalescence, formation zone effects, hadron helicity selection rules, spin correlations, higher twist effects, and nuclear diffraction - as tools for probing hadron structure and the propagation of quark and gluon jets in nuclei. Many of these processes can be studied in electroproduction, utilizing internal targets in storage rings. We also review several areas where there has been significant theoretical progress in determining the form of hadron and nuclear wavefunctions, including QCD sum rules, lattice gauge theory, and discretized light-cone quantization. 98 refs., 40 figs., 2 tabs.

42610 (ZfK—587) Contribution to phenomenology of phase transitions in nuclear matter. Kaempfer, B. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). May 1986. 75p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE87702872.

A review is given on the phenomenology of phase transitions in nuclear matter and neutron matter. We deal with (1) the liquid-gas transition in expanding nuclear systems and collapsing stellar cores, (2) the pion condensation in neutron stars and the direct pion emission in relativistic heavy ion collisions and (3) the deconfinement transition in neutron stars, in the early universe and in the compression/expansion stage of heavy ion reactions.

42611 (ZfK—596) Consistent treatment of one-body dynamics and collective fluctuations. Pfitzner, A. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). Sep 1986. 12p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702874.

We show how the residual coupling deltaV between collective and intrinsic motion induces correlations, which lead to fluctuations of the collective variables and to a redistribution of single-particle occupation numbers rho/sub α/. The evolution of rho/sub α/ and of the collective fluctuations is consistently described by a coupled system of equations, which accounts for the dependence of the transport coefficients on rho/sub α/, and for the dependence of the transition rates in the master equation on the collective variances.

42612 (ZfK—598) Description of nuclear states as structures in on open quantum mechanical system. Rotter, I. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). Sep 1986. 22p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702876.

The problem of coexistence of collective and independent-particle motion in nuclei is discussed in the framework of a model which describes the nucleus as an open quantum mechanical system. It is shown, by means of numerical results, that selforganization takes place and that structures in space and time at low as well as at high excitation energies are formed. The slaving principle is well established by nuclear structure calculations. The lifetime of the structures is identified with an internal time. Irreversibility appears on a microscopic level. Lifetime measurements at high level density and other experimental investigations allow to proof the statements given.

42613 Variational bounds for the triton. Friar, J.L.; Gibson, B.F.; Payne, G.L. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *C: Nuclear Physics;* **36**: No. 3, 1138-1139(Sep 1987).

Variational bounds for the Reid soft core and Argonne V/sub 14/ potentials are extended through the J = 8 partial waves of those nucleon-nucleon forces using Faddeev wave functions calculated with the J≦4 partial waves. We verify our previous conjecture that the additional components add roughly 10 keV to the binding energy, and that the convergence of the binding energy with respect to the nucleon-nucleon partial-wave angular momentum is roughly geometrical.

42614 Charge dependence in the triton. Friar, J.L.; Gibson, B.F.; Payne, G.L. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *C: Nuclear Physics;* **36**: No. 3, 1140-1143(Sep 1987).

It is argued that the charge dependence of the nuclear force (V/sub nn/not =V/sub np//sup s/) can be accounted for exactly in triton binding energy calculations to first order in the difference V/sub nn/-V/sub np//sup s/ by replacing the $^1S_0$ interaction by the potential combination (2/3V/sub nn/+ 1) / 3 V/sub np//sup s/. .AE

42615 Fermion dynamical symmetry model of nuclei: Basis, Hamiltonian, and symmetries. Wu, C.; Da Hsuan Feng; Chen, X.; Chen, J.; Guidry, M.W. (Department of Physics and Atmospheric Science, Drexel University,). *Physical Review* [*Section*] *C: Nuclear Physics;* **36**: No. 3, 1157-1180(Sep 1987).

A fermion dynamical symmetry model is presented. The model has a rich variety of dynamical symmetries, with fully microscopic connections between these dynamical symmetries and the underlying shell structure. In the low angular momentum region, without explicit introduction of bosons, all the dynamical symmetries contained in the phenomenological interacting boson model are recovered. Furthermore, the model predicts several new dynamical symmetries, one of which has recently been empirically verified, and has limits appropriate to the study of high-spin physics.

42616 Systematic evidence for degrees of freedom beyond the sd phenomenological interacting boson model. Casten, R.F.; Gelberg, A.; von Brentano, P. (Brookhaven National Laboratory, Upton, New York, 11973). *Physical Review* [*Section*] *C: Nuclear Physics;* **36**: No. 3, 1225-1228(Sep 1987). Contract AC02-76CH00016.

The data in deformed heavy nuclei are surveyed to disclose systematic evidence for the need for degrees of freedom outside the sd phenomenological interacting boson model (and most geometrical models) even at relatively low energies.

42617 /sup 37/Cl solar neutrino capture cross section. Adelberger, E.G.; Haxton, W.C. (Department of Physics, University of Washington, Seattle, Washington 98195). *Physical Review* [*Section*] *C: Nuclear Physics;* **36**: No. 3, 879-882(Sep 1987).

We argue that the standard derivation of the Gamow-Teller contribution to the /sup 37/Cl solar neutrino capture cross section from the /sup 37/Ca delayed proton spectrum yields a B(GT) distribution that is too weak and shifted to lower excitation energies. Because the redistribution of Gamow-Teller strength occurs primarily above the analog state, where the neutrino reaction phase space is small, it has only a small effect (4%) on the solar neutrino cross section. However, our observations help resolve the discrepancy between the /sup 37/Ca β-decay and /sup 37/Cl(p,n) Gamow-Teller mappings.

42618 Comment on "Reduction of coupled equations for heavy ion reactions". Esbensen, H.; Landowne, S.; Price, C. (Physics Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review* [*Section*] *C: Nuclear Physics;* **36**: No. 3, 1216-1217(Sep 1987). Contract W-31-109-ENG-38.

A recently obtained reduced set of coupled equations represents the scattering in the rotating frame. The corresponding scattering amplitude simplifies such that it is equivalent to having spinless states. Good agreement with exact calculations is obtained, including those for backward scattering angles.

42619 **Hot nuclear matter at low density.** Pratt, S.; Siemens, P.; Usmani, Q.N. (Tennessee Univ., Knoxville; Oak Ridge National Lab., TN; Aligarh Muslim Univ., India). *Physics Letters [Section] B;* **189**: No. 1/2, 1-6(30 Apr 1987).

The equation of state of nuclear matter at high excitation is calculated in a virial expansion of the densities of the light nuclei ($M \leqq 4$). The virial coefficients are shown to depend only on properties of the S-matrix for light particle scattering. Relative concentrations of these species are estimated and compared to data from heavy-ion experiments to infer a breakup density and temperature. The breakup density is remarkably low, about 1/100th of normal nuclear density.

42620 **Exclusive hadronic and nuclear processes in QCD.** Brodsky, S. (Stanford Linear Accelerator Center, Stanford Univ., Stanford, CA 94305). pp 3-26 of Workshop on nuclear chromodynamics: Quarks and gluons in particles and nuclei. Brodsky, S.; Moniz, E. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8508127—). Contract AC03-76SF00515.

From Nuclear chromodynamics: quarks and gluons in particles and nuclei; Santa Barbara, CA, USA (12 Aug 1985).

With the advent of quantum chromodynamics as a complete theory of the strong interactions, one can now anticipate understanding the underlying dynamics and composition of both hadrons and nuclei at a fundamental level. In the last few years considerable progress has been made in calculating short distance hadronic scattering and production amplitudes in terms of quark and gluon subprocesses. This in turn has led to a basic understanding of exclusive hadron and nuclear scattering processes at large momentum transfer as well as progress in describing the structure of hadronic and nuclear wavefunctions in terms of their fundamental quark and gluon degrees of freedom.

42621 **Physics with polarized photons.** Matone, G.; De Pascale, M.P.; Giordano, G.; Babusci, D.; Bernabei, R.; Casano, L.; D'Angelo, S.; Incicchitti, A.; Mattioli, M.; Picozza, P. (Brookhaven National Lab., Upton, NY 11973). pp 505-517 of Proceedings of the fifth course of the international school of intermediate energy nuclear physics. Bergere, R.; Costa, S.; Schaerf, C. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-850634—).

From International school for intermediate energy nuclear physics; Verona, Italy (20 Jun 1985).

The authors argue the applications of principles presented to other systems of fermions like nucleons in the nucleus or quarks or partons in a nucleon. In the case of an oriented nucleus this is just the extension of the Compton scattering on bound nucleons where, besides isolating the spin dependent part, the emphasis is concentrated on the nucleon spin distribution. The electrons in the bunch are separated by relatively large distances and interact only electromagnetically, whereas nucleons or quarks are in close proximity and interact strongly: final state interactions could greatly complicate this potentially simple picture. Therefore in order to proceed along this line, the authors make the assumption that, during the scattering, one can neglect the interactions between the nucleons and the momentum transfer to be high enough to resolve details on a length scale much less than the nucleus size.

42622 **K meson-nucleus interactions: Strangeness and nuclear matter.** Kahana, S. (Physics Dept., Brookhaven National Lab., Upton, NY 11973). pp 420-434 of Proceedings of the fifth course of the international school of intermediate energy nuclear physics. Bergere, R.; Costa, S.; Schaerf, C. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-850634—). Contract AC02-76CH00016.

From International school for intermediate energy nuclear physics; Verona, Italy (20 Jun 1985).

A brief review is provided of some straightfoward K-nuclear and Λ-hypernuclear systems. A discussion of less straightfoward speculations of H-dibaryons and strange quark matter by many authors, is also given.

42623 **Nuclear structure investigations using the (e,e'x) reaction.** Cardman, L.S. (Nuclear Physics Lab. and Dept. of Physics, Univ. of Illinois at Urbana-Champaign, 23 Stadium Drive, Champaign, IL 61820). pp 163-187 of Proceedings of the fifth course of the international school of intermediate energy nuclear physics. Bergere, R.; Costa, S.; Schaerf, C. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-850634—).

From International school for intermediate energy nuclear physics; Verona, Italy (20 Jun 1985).

The experimental possibilities for the application of electron scattering coincidence techniques to the study of nuclear bound states and giant multipole resonances are presented. The advantages of coincidence measurements are discussed, and are illustrated with examples from recent experimental and theoretical investigations.

42624 **O/sup +/ ⇌ O/sup -/ transitions in A=16.** Garvey, G.T. (Physics Div., Argonne National Lab., 9700 South Cass Ave., Argonne, IL 60439). pp 193-216 of Nuclear spectroscopy and nuclear reactions. Ejiri, H.; Fukuda, T. Teaneck, NJ; World Scientific Pub. Co. (1984). (CONF-840312—).

From Conference on the changing structure of the world oil industry; Guildford, UK (22 Mar 1984).

The author presents data concluding a considerable increase in the accuracy and number of weak pseudoscalar transitions have been experimentally determined. For the most part, the results are reliable. More refined nuclear structure calculations going to higher order in perturbation theory and employing finite single particle potentials to calculate the transition matrix elements are showing consistently and convincingly that the time-like part of the axial current has to be enhanced. Directly supporting this fact is the examination of the value of the time-like part of allowed axial vector decays. In these cases the small contribution of the time-like part to the overall rate must be obtained from angular correlation measurements. The data exists for mass 12 as it was obtained as a by-product of experiments searching for second class currents. Agreement with experiment is obtained in given calculations employing core polarization and enhancement of the time component by meson exchange current. Unfortunately, in this case the two effects cancel one another so the final result is nearly what one would calculate with simple wave functions and no mesonic enhancement. Thus, the enehancement effect, while present, is not evident on the surface.

42625 **Nuclear and particle physics aspects of hyperon and antinucleon interactions.** Dover, C.B. (Brookhaven National Lab., Upton, NY). pp 727-740 of Nuclear spectroscopy and nuclear reactions. Ejiri, H.; Fukuda, T. Teaneck, NJ; World Scientific Pub. Co. (1984). (CONF-840312—). Contract AC02-76CH00016.

From Conference on the changing structure of the world oil industry; Guildford, UK (22 Mar 1984).

A discussion is given of hyperon (Y) and antinucleon (N-bar) interactions with nucleons and nuclei, emphasizing some of the future prospects for nuclear structure and elementary particle physics studies at LEAR or a future "kaon factory".

42626 **Study of giant resonances with pions.** Baer, H.W. (Medium-Energy Physics Div., Los Alamos National Lab., Los Alamos, NM 87545). pp 413-438 of Nuclear spectroscopy and nuclear reactions. Ejiri, H.; Fukuda, T. Teaneck, NJ; World Scientific Pub. Co. (1984). (CONF-840312—).

From Conference on the changing structure of the world oil industry; Guildford, UK (22 Mar 1984).

Recent results on giant resonances obtained with pion inelastic scattering and with single- and double-charge-exchange scattering are reviewed. The states discussed are isobaric analog states, double-isobaric analog states, and isovector L = 0, 1, and 2 collective states.

6540 Radiation And Shielding Physics

REFER ALSO TO CITATION(S) 41550, 41731, 41765

42627 (EFI—827(54)-85) Production of relativistic electron-photon showers in the field of electromagnetic radiation. Agaronyan, F.A.; Vardanyan, V.V. (Erevanskij Fizicheskij Inst. (USSR)). 1985. 26p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. File Number DE87702678.

The development of electromagnetic cascade initiated by relativistic electrons and gamma-rays in isotropic photon gases is considered. The relativistic kinetic equations for cascade particles in the energy range of $E>>(mc^2)^2/w$ (m is the electron rest mass and w is the energy of field photons) are derived. Energy spectra of particles at different depths of cascade penetration are obtained.

42628 (JINR—D-10-11-84-818, pp 145-147) On some inverse problems of mathematical physics. Prilepko, A.I. (Moskovskij Inzhenerno-Fizicheskij Inst., USSR). 1985. (In Russian). NTIS (US Sales Only), PC A16/MF A01. File Number DE87780164. (CONF-8309402—).

From 5. international meeting on problems of mathematical simulation, programming, and mathematical methods for solving the physical problems; Dubna, USSR (20 Sep 1983).

A series of inverse problems on determining the factors and right parts of equations in mathematical physics is considered. In particular, a nonstationary multivelocity anisotropic equation of neutron transport is studied. Formulation of a number of the potential theory inverse problems aimed at determining the shape and density of an attracting body according to the external or internal values of a total potential of masses and an elementary layer is analyzed. The questions of existence, uniqueness and stability of the above-mentioned problem solutions are investigated.

42629 (Zfl—64, pp 17) SPALT2 - calculation of dose rate distributions behind shielding walls and their increase with consideration of total or partial slits in the wall. Remer, M. Dec 1986. NTIS (US Sales Only), PC A03/MF A01. File Number DE87702867.

In Computer codes for problems of isotope and radiation research.

42630 (ZfK—585) Neutron point-flux calculation by Monte Carlo. Eichhorn, M. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). Apr 1986. 26p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE87702871.

A survey of the usual methods for estimating flux at a point is given. The associated variance-reducing techniques in direct Monte Carlo games are explained. The multigroup Monte Carlo codes MC for critical systems and PUNKT for point source-point detector-systems are represented, and problems in applying the codes to practical tasks are discussed.

42631 Different aspects of the milne problem (based on energy estimates). Bardos, C.; Caflisch, R.; Nicolaenko, B. (Centre de Mathematiques Appliquees, Ecole Normale Superieure, 45 rue d'Ulm, Paris 75005 France, et Universite de Paris Nord, Avenue Jean Baptiste Clement, 93430 Villetaneuse). *Transport Theory and Statistical Physics;* **16**: No. 3, 561-585(May 1987).

We describe a method based on energy estimates for the study of the half space milne problem. To show the range of application of the method we start from the linear transport equation and we consider other problems (including some short summaries of results described in companion papers). On the other hand, we do not consider classical or more explicit methods, which were introduced already long time ago.

42632 Generalized kinetic equations. Greenberg, W.; van der Mee, C.V.M.; Zweifel, P.F. (Virginia Polytechnic Institute and State Univ., Blacksburg). *Integral Equations and Operator Theory;* **7**: 60-95(1984). Contract AS05-80ER10711.

The authors study the abstract differential equation $T\partial f/\partial x + Af = 0$ on a Hilbert space H, which represents a variety of different kinetic equations; T is assumed bounded and self-adjoint on H, and A (unbounded) positive self-adjoint and Fredholm. For partial-range boundary conditions of $0 \leqq x <$ infinity, they prove existence and (non-) uniqueness theorems and give representations of the solution. Various examples from neutron transport, radiative transfer of polarized and unpolarized light, and electron transport are given. 39 references.

6550 Medical Physics

REFER ALSO TO CITATION(S) 40652, 42110, 42142, 42246

42633 (BFR-D—7-1986) Indoor ionizing radiation. Technical solutions and remedial strategy. Ericson, S.O.; Lindvall, T.; Maansson, L.-G. (Swedish Council for Building Research, Stockholm). 1986. 51p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87751947.

Radiation in indoor air is discussed in the perspective of the effective dose equivalents from other sources of radiation. Estimates of effective doses equivalents from indoor radon and its contribution to lung cancer incidence are reviewed. Swedish experiences with cost effective remedial actions are presented. The authors present optimal strategies for screening measurements and remedial actions in cost-benefit perspective. (author). With 105 refs.

42634 (GR—85-5e) Radioactivity in building materials. Interim report on potential consequences for the Dutch population of using waste substances with an enhanced concentration of radionuclides as building material for houses. (Gezondheidsraad, The Hague (Netherlands)). 12 Feb 1985. 95p. NTIS (US Sales Only), PC A05/MF A01. File Number DE87702716.

The present report, drawn up at the request of the former Minister of Public Health and Environmental Affairs of the Netherlands, discusses the potential radiological consequences for the population of the Netherlands of using waste materials as building materials in housing construction. (Auth.). Translation of Interim advies inzake de mogelijke consequenties voor de Nederlandse bevolking van het toepassen van afvalstoffen met een verhoogd gehalte aan radionucliden als bouwstof, GR--85-5; 45 references, 2 figures, 17 tables.

42635 (IAEA-TECDOC—382, pp 59-65) Basic safety standards for radiation protection. Gonzalez, A. (International Atomic Energy Agency, Vienna, Austria. Div. of Nuclear Safety). Oct 1986. (In Spanish). NTIS (US Sales Only), PC A16/MF A01. File Number DE87702732. (CONF-8410472—).

From Regional course on legislation and regulation of nuclear safety for Latin American countries; Montevideo, Uruguay (15 Oct 1984).

In the light of the IAEA Basic Safety Standards for Radiation Protection, the author deals with: 1) the system of doses limitation; 2) basic concepts for, and problems relating to, the application ionizing of radiation; 3) brief statement on the perspectives of the dose limitation system. 4 figs.

42636 (INIS-mf—10916, pp 1017) Determination of dose outside a beam in telecobalt therapy. Stipcic-Solic, N.; Kontus, L.; Georgiev, S.; Bobus, T.; Brumini, D.; Gajic, M. (Clinical Hospital Center, Rijeka, Yugoslavia). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

From 14. international cancer congress; Budapest, Hungary (21 Aug 1986).

42637 (NRCN—568) Measurement of penetrating and non-penetrating radiation from bare and shielded uranium. Ben-Shachar, B.; German, U.; Weiser, G. (Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev). Aug 1986. 17p. (In Hebrew). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702853.

One of the difficulties of the routine personnel dosimetry is the measurement of the non-penetrating dose. In this work, the pen-

etrating and non-penetrating radiation at different distances near natural uranium source was measured. The calibration factor for the non-penetrating dose was experimentally found. An expression is presented for the calculation of the fluence at different distances from a half infinite source, striking a TLD chip and the experimental results are compared to the calculated ones. The radiation field of the source shielded by aluminium and iron plates of different thickness, was also measured.

6560 Condensed Matter Physics

REFER ALSO TO CITATION(S) 41315, 41341, 41384, 41550, 42357

42638 **(CEA-CONF—8337) Harmonic excitations in quasicrystals.** Luck, J.M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Inst. de Recherche Fondamentale (IRF)). Mar 1986. 7p. (CEA-SPhT—86-021; CONF-8603112—2). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752259.

From Winter school on aperiodic crystals; Les Houches, France (11 Mar 1986).

The harmonic excitations (phonons) of quasicrystals are studied in a simple one-dimensional model. The spectrum is a Cantor set, which exhibits selfsimilarity properties. The eigenstates are generically "critical", i.e. neither extended nor localized.

42639 **(ECN—197) Characterization of the dimensions of colloidal calcium carbonate dispersions in toluene with neutron small-angle scattering.** Vlak, W.A.H.M.; Mortensen, K.; Dorrepaal, J. (Netherlands Energy Research Foundation, Petten). Feb 1987. 18p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702671.

Calcium carbonate particles, stabilized by a surface layer, and dispersed in toluene are investigated with neutron small-angle scattering. Estimates for the dimensions of the core particle and the layer have been obtained: the layer thickness is 8.6 A and the core particle radius is 16.5 A. The limits within which these results are valid are indicated. 5 references, 5 figures, 2 tables.

42640 **(EFI—828(55)-85) Angular dependence of electron total energy dump in thick diamond monocrystals.** Avakyan, R.O.; Avakyan, Eh.O.; Agaronyan, A.V. (Erevanskij Fizicheskij Inst. (USSR)). 1985. 18p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702679.

Preliminary results of the experiment on measurement of angular dependence of electron energy total yield in diamond monocrystals under channeling regime are reported.

42641 **(EFI—831(58)-85) Radiation and multiple scattering of high energy electrons at planar channeling.** Avakyan, A.R.; Chi Yang; Beloshitskij, V.V. (Erevanskij Fizicheskij Inst. (USSR)). 1985. 14p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702682.

The multiple scattering of high energy electrons passing through monocrystals in the case of planar channeling is investigated. It is shown that particles moving near the top of the potential barrier undergo depressed multiple scattering. This displays in the angular distribution of passing electrons. Radiation spectra are calculated taking into account this effect. A comparison of the theory with the experiment shows a good agreement.

42642 **(EFI—833(60)-85) Defect and color centers induced in corundum and ruby by high-energy electrons. 4. Light decoloration of color centers of corundum grown by different methods.** Gevorkyan, V.A.; Ezoyan, R.K. (Erevanskij Fizicheskij Inst. (USSR)). 1985. 20p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702684.

Using the method of light decoloration of colour centers induced in Verneuli corundum crystals by 50-MeV electrons, there was found a decrease in intensity of additional absorption over the whole spectrum range (2-6.2 eV) under photoexcitation of irradiated crystals with 2.64 eV quanta. Separate absorption bands attributed to Cr^{3+} and Cr^{4+} centers are distinduished in the spectrum. Recharge of F- and F^+ -centers of HDC crystals irradiated with 50-MeV electrons at 300 deg and 77 deg K is investigated in detail. It is found that photoexcitation with 6.05-eV photons leads to decrease in absorption intensity of F-centers and increases in that of F^+-centers. Whereas in case of 4.8 eV photoexcitation an opposite picture can be observed. The obtained results are in good agreement with the experimental data. 14 references, 5 figures.

42643 **(IAE—4215/11) Defect formation at channeling.** Titov, V.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1985. 16p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702724.

Analysis of energy transfer from fast ion moving along crystal lattice linear channel to the chain atoms fringing the channel is carried out. It is stated that parallel ion beam incident on crystal surface in general case is separated into three fluxes: 1) isotropic flux; 2) slightly channeled flux forming the lattice defects along its trajectory; 3) ideally channeled ion flux moving along the channels inducing no defects. Criteria of defectless channeling are formulated. Main qualitative characteristics of defect formation at channeling are calculated for several ion types in silicon. 8 references, 3 figures, 6 tables.

42644 **(IC—86/152) Force sum rules at surfaces.** Kaschner, R.; Ziesche, P. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1986. 9p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702568.

Hellmann-Feynman theorems for partially extended arrangements of atoms (chains, strips, layers, wires and slabs) are derived and applied to one-, two-, and three-dimensional solids. The derivatives of the bulk energy with respect to the lattice spacings are related to the Hellmann-Feynman forces in the corresponding semi-infinite unrelaxed solids. These forces have to alternate going from the surface into the bulk provided that the latter is in equilibrium. 15 references.

42645 **(IC—86/161) Short-range order for CuAu binary alloys: pseudopotential theory of alloys revisited.** Khwaja, F.A.; Saif-ud-din. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1986. 17p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702569.

The electronic theory of short-range order developed is applied to the analysis of published experimental data on short-range order parameter for CuAu system. The analysis of the failure of perfectly periodic lattice approximation assumed in the previous theoretical procedure to predict the SRO in CuAu system is made. It is shown that in the improved procedure, whereby one accounts for the static lattice distortions due to difference in sizes of atoms, one faithfully reproduces the experimentally observed short-range order in CuAu system. The scope of a further extension of the present theory is discussed. 24 references, 1 figure, 1 table.

42646 **(IC—86/212) Phonon-assisted two-photon transitions in semiconductors.** Hassan, A.R. (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1986. 8p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702572.

The effect of the non-parabolicity of the energy bands on the indirect two-photon transition is theoretically studied. An expression for the absorption coefficient valid both near and far from the energy gap is given. Numerical results, compared with recent experimental data on AgCl, show that the dominant transition mechanisms are of the allowed-allowed type near and far from the edge. 6 references, 2 figures.

42647 **(IC—86/235) Applications of Moessbauer spectroscopy in cement studies.** Hassaan, M.Y.; Eissa, N.A. (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1986. 51p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87702575.

In the last two decades Moessbauer spectrometer has been employed to investigate cement and its clinker. In this work some of these investigations are exhibited briefly hoping that this would facilitate further investigations. It has already been seen that Moessbauer spectroscopy gives good information about some vague

points which were present before using this technique as a tool in cement studies such as clinker formation, iron solubility, the iron states in the different phases of clinker as well as the effect of hydration at different times on the states of iron cement pastes. Methods for the quality control of the manufactured clinker, the evaluation of the degree of hydration and the compressive strength have been assessed. A concept about the Moessbauer spectroscopy is presented. 41 references, 22 figures, 8 tables.

42648 **(IC—86/273) Electronic structure of crystalline NaSn.** El-Hasan, M.; Tomak, M. (International Centre for Theoretical Physics, Trieste (Italy)). Oct 1986. 6p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702583.

The electronic structure calculation of solid NaSn using the recursion method is reported. The crystalline structure is assumed to be CsCl. The Fermi level is found to intersect the broad Sn p-band complex. 7 references, 1 figure.

42649 **(IC—86/274) Localized orbital description of ideal vacancies in GaP and GaSb.** Erbarut, E.; Tomak, M. (International Centre for Theoretical Physics, Trieste (Italy)). Oct 1986. 10p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702584.

Gaussian orbitals of s and p symmetry and an empirical pseudopotential Hamiltonian is employed for the study of electronic structures of ideal vacancies in GaP and GaSb. A reasonably accurate description of band structures and densities of states are attained. 13 references, 4 figures, 3 tables.

42650 **(IC—86/275) Differential thermal analysis of the glassy system AsSe-AsTe.** El Den, M.B.; El Mously, M.K. (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1986. 12p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702585.

Thermal induced phase transformation for the system AsSe-AsTe has been studied using DTA. The dependence of the characteristic temperature Tg, Tc and Tm on the ratio of Se/Tc has been determined. The increase of Te content leads to the decrease of both Tg and Tc, i.e. tellurium enhances the crystallization process in these glasses exactly as in the case of $AsSe_s$2-x/Te/sub x/ and $AsSe_s$2-x/Te/sub x/. The kinetic calculations have also been tried. Reasonable results have been obtained for two compositions only AsSe/sub 0.5/Te/sub 0.5/ and AsSe/sub 0.1/Te/sub 0.9/ with E/sub cryst/ equal to 31.0 kcal/mole for the first and 45 and 65 kcal/mole for the second. The other compositions either do not crystallize completely or have complicated and overlapped peaks. 12 references, 3 figure, 2 tables.

42651 **(INIS-BR—648) Photodissociation of OH/sup -/ ions in RbCl crystals.** Baldochi, S.L.; Morato, S.P. (European Physical Society, Geneva (Switzerland)). 1986. 1p. (CONF-8609138—7-Summ.). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702757.

From 5. europhysical topical conference on lattice defects in ionic materials; Madrid, Spain (8 Sep 1986).

Published in summary form only.

42652 (INIS-BR—669, pp 31) **Molecular dynamic in A_2 Fe Cl_5 H_2O (A=NH_4,K) salts.** Partiti, C.S.M.; Piccini, A.; Rechenberg, H.R. (Sao Paulo Univ., Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. File Number DE87702777. (CONF-8512132—).

From 4. national meeting of Moessbauer spectroscopy; Rio de Janeiro, Brazil (11 Dec 1985).

42653 (INIS-BR—669, pp 34) **Moessbauer study of the Sn/sub x/ NH/sub 3i-x/ system: phase dissolved in tin.** Saitovitch, E.M.B.; Rodrigues, E.; Drago, V.; Miklit, H. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro; Santa Catarina Univ., Florianopolis, Brazil; Bochum Univ., Germany, F.R.). 1986. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. File Number DE87702777. (CONF-8512132—).

From 4. national meeting of Moessbauer spectroscopy; Rio de Janeiro, Brazil (11 Dec 1985).

42654 (INIS-BR—669, pp 36) **Study by Moessbauer spectroscopy of the iron-gallic ink from a 18th century manuscript.** 1986. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. File Number DE87702777. (CONF-8512132—).

From 4. national meeting of Moessbauer spectroscopy; Rio de Janeiro, Brazil (11 Dec 1985).

42655 (INIS-BR—669, pp 38) **Magnetic properties and electronic strucutre of pseudo-binary compounds of Laves phase type: perspectives.** Gomes, A.A.G. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1986. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. File Number DE87702777. (CONF-8512132—).

From 4. national meeting of Moessbauer spectroscopy; Rio de Janeiro, Brazil (11 Dec 1985).

42656 (INIS-BR—669, pp 40) **Studies of hyperfine magnetic fields in Heusler alloys of (Rh/sub 1-x/ Ni/sub x/)$_2$ MnSn.** Ramos, S.M.M.; Cunha, J.B.M. da; Schreiner, W.H. (Rio Grande do Sul Univ., Porto Alegre, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. File Number DE87702777. (CONF-8512132—).

From 4. national meeting of Moessbauer spectroscopy; Rio de Janeiro, Brazil (11 Dec 1985).

42657 (INIS-BR—669, pp 42) **Study of hyperfine fields in sp site of Heusler alloys of Rh_2MnZ (Z=In, Sn, Sb) type by Moessbauer spectroscopy.** Ramos, S.M.M.; Cunha, J.B.M. da; Vasquez, A.; Jha, S. (Rio Grande do Sul Univ., Porto Alegre, Brazil; Cincinnati Univ., OH). 1986. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. File Number DE87702777. (CONF-8512132—).

From 4. national meeting of Moessbauer spectroscopy; Rio de Janeiro, Brazil (11 Dec 1985).

42658 (INIS-BR—669, pp 49) **Hyperfine interactions and magnetic transitions in R/sub 1.1/Fe_4B_4 (R=Y,La,Ce,Pr,Nd,Sm,Gd,Tb,Dy,Ho,Er,Lu).** Rechenberg, H.R.; Paduan Filho, A.; Missell, F.P. (Sao Paulo Univ., Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. File Number DE87702777. (CONF-8512132—).

From 4. national meeting of Moessbauer spectroscopy; Rio de Janeiro, Brazil (11 Dec 1985).

42659 (INIS-BR—669, pp 53) **Moessbauer effect of ^{197}Au, ^{193}Ir, ^{99}Ru in VH/sub x/ and ^{125}Te em PdH/sub x/.** Iannarella, L.V.; Zelger, M.; Wagner, F.E. (Universidade Federal Rural do Rio de Janeiro, Brazil; Muenchen Univ., Germany, F.R.). 1986. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. File Number DE87702777. (CONF-8512132—).

From 4. national meeting of Moessbauer spectroscopy; Rio de Janeiro, Brazil (11 Dec 1985).

42660 (INIS-BR—669, pp 9) **Moessbauer effect study of magnetic properties of Fe/sub 1-q/ Alq $0<q<0.5$, alloys in the disordered phase.** Alcazar, G.A.P.; Silva, E.G. da. (Minas Gerais Univ., Belo Horizonte, Brazil). 1986. NTIS (US Sales Only), PC A04/MF A01. File Number DE87702777. (CONF-8512132—).

From 4. national meeting of Moessbauer spectroscopy; Rio de Janeiro, Brazil (11 Dec 1985).

42661 (INIS-BR—669, pp 11) **Electronic structure, magnetic properties, Mossbauer isomer shifts and hyperfine fields of disordered Fe-rich Fe-Al alloys.** Chacham, H.; Silva, E.G. da; Guenzburger, D.; Ellis, D.E. (Minas Gerais Univ., Belo Horizonte, Brazil; Northwestern Univ., Evanston, IL). 1986. NTIS (US Sales Only), PC A04/MF A01. File Number DE87702777. (CONF-8512132—).

From 4. national meeting of Moessbauer spectroscopy; Rio de Janeiro, Brazil (11 Dec 1985).

42662 (INIS-BR—669, pp 12) **Microstructure of the Santa Catharina meteorite.** (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro; Minas Gerais Univ., Belo Horizonte, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. File Number DE87702777. (CONF-8512132—).

From 4. national meeting of Moessbauer spectroscopy; Rio de Janeiro, Brazil (11 Dec 1985).

42663 (INIS-BR—669, pp 14) **Fe-Ni phases in hi-rich iron meteorites.** (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro; Minas Gerais Univ., Belo Horizonte, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. File Number DE87702777. (CONF-8512132—).

From 4. national meeting of Moessbauer spectroscopy; Rio de Janeiro, Brazil (11 Dec 1985).

42664 (INIS-BR—669, pp 16) **Evolution of Fe-C compounds obtained by ion implantation and submitted to thermal treatment under pressure.** Oliveira, L.S. de; Silva, M.T.X.; Viccaro, P.J.; Jornada, J.A.H. da. (Santa Catarina Univ., Florianopolis, Brazil; Rio Grande do Sul Univ., Porto Alegre, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. File Number DE87702777. (CONF-8512132—).

From 4. national meeting of Moessbauer spectroscopy; Rio de Janeiro, Brazil (11 Dec 1985).

42665 (INIS-BR—669, pp 17) **Thermal evolution of iron compounds obtained from carbon implantation in iron.** Oliveira, L.S. de; Silva, M.T.X.; Viccaro, P.J. (Santa Catarina Univ., Florianopolis, Brazil; Rio Grande do Sul Univ., Porto Alegre, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. File Number DE87702777. (CONF-8512132—).

From 4. national meeting of Moessbauer spectroscopy; Rio de Janeiro, Brazil (11 Dec 1985).

42666 (INIS-BR—669, pp 19) **Metallic phase in chondrites.** (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1986. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. File Number DE87702777. (CONF-8512132—).

From 4. national meeting of Moessbauer spectroscopy; Rio de Janeiro, Brazil (11 Dec 1985).

42667 (INIS-BR—669, pp 21) **Hyperfine parameters of almondine by Moessbauer effect.** Cunha, J.B.M. da; Kunrath, J.I.; Vasquez, A.; Oliveira, J.C.P. de. (Rio Grande do Sul Univ., Porto Alegre, Brazil; Ceara Univ., Fortaleza, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. File Number DE87702777. (CONF-8512132—).

From 4. national meeting of Moessbauer spectroscopy; Rio de Janeiro, Brazil (11 Dec 1985).

42668 (INIS-BR—669, pp 22) **Moessbauer spectroscopy in Sn-Ta mineral.** Oliveira, J.C.P. de; Kunrath, J.I.; Vasquez, A. (Ceara Univ., Fortaleza, Brazil; Rio Grande do Sul Univ., Porto Alegre, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. File Number DE87702777. (CONF-8512132—).

From 4. national meeting of Moessbauer spectroscopy; Rio de Janeiro, Brazil (11 Dec 1985).

42669 (INIS-BR—669, pp 24) **Analysis of temperature influence on hyperfine interactions in a Hedenbergite - acmite natural sample.** Oliveira, J.C.P. de; Vasquez, A.; Kunrath, J.I. (Ceara Univ., Fortaleza, Brazil; Rio Grande do Sul Univ., Porto Alegre, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. File Number DE87702777. (CONF-8512132—).

From 4. national meeting of Moessbauer spectroscopy; Rio de Janeiro, Brazil (11 Dec 1985).

42670 (INIS-BR—669, pp 26) **Synthetic ferrous hureaulite.** Moreira, L.F.; Mattievich, E.; Cano, F.H. (Rio de Janeiro Univ., Brazil; Instituto de Quimica Fisica Rocasalano, Madrid, Spain). 1986. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. File Number DE87702777. (CONF-8512132—).

From 4. national meeting of Moessbauer spectroscopy; Rio de Janeiro, Brazil (11 Dec 1985).

42671 (INIS-BR—669, pp 43) **Production and characterization of Sn/sub 1-x/Mn/sub x/ amorphous alloys.** Drago, V.; Saitovitch, E.M.B. (Santa Catarina Univ., Florianopolis, Brazil; Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1986. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. File Number DE87702777. (CONF-8512132—).

From 4. national meeting of Moessbauer spectroscopy; Rio de Janeiro, Brazil (11 Dec 1985).

42672 (INIS-BR—669, pp 46) **Moessbauer study of Sn/sub 1-x/Mn/sub x/ amorphous alloys.** Drago, V.; Saitovitch, E.M.B. (Santa Catarina Univ., Florianopolis, Brazil; Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1986. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. File Number DE87702777. (CONF-8512132—).

From 4. national meeting of Moessbauer spectroscopy; Rio de Janeiro, Brazil (11 Dec 1985).

42673 (INIS-BR—669, pp 52) **Study of the magnetic properties of the Laves phase $TiFe_2$.** Silva, E.G. da; Mansur, R.A.; Sa Barreto, F.C. de. (Minas Gerais Univ., Belo Horizonte, Brazil). 1986. NTIS (US Sales Only), PC A04/MF A01. File Number DE87702777. (CONF-8512132—).

From 4. national meeting of Moessbauer spectroscopy; Rio de Janeiro, Brazil (11 Dec 1985).

42674 (INIS-BR—669, pp 55) **Study by Moessbauer Spectroscopy of the (Mn, $Fe)_3O_4$ natural ferrite - Jacobsite.** (Ceara Univ., Fortaleza, Brazil; Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1986. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. File Number DE87702777. (CONF-8512132—).

From 4. national meeting of Moessbauer spectroscopy; Rio de Janeiro, Brazil (11 Dec 1985).

42675 (INIS-BR—669, pp 56) **Systematic study of the substitution capability of ^{119}Sn implanted in silicon substrates.** Scherer, E.M.; Baumvol, I.J.R. 1986. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. File Number DE87702777. (CONF-8512132—).

From 4. national meeting of Moessbauer spectroscopy; Rio de Janeiro, Brazil (11 Dec 1985).

42676 (INIS-BR—669, pp 18) **Effects of α ions post-bombardment on the thermal evolution of nitrogen precipitates in iron.** Behar, M.; Viccaro, P.J.; Silva, M.T.X.; Vasquez, A.; Santos, C.A. dos; Zawislak, F.C. 1986. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. File Number DE87702777. (CONF-8512132—).

From 4. national meeting of Moessbauer spectroscopy; Rio de Janeiro, Brazil (11 Dec 1985).

42677 (INIS-mf—10918, pp 14) **On weak mach reflection for small wedge angle.** Sakurai, A. (Tokyo Univ., Japan). 1986. NTIS (US Sales Only), PC A03/MF A01. File Number DE87780149. (CONF-8606316—Absts.).

From 6. Mach reflection symposium; Beer Sheva, Israel (29 Jun 1986).

42678 (INIS-mf—10918, pp 43) **Spallation and dynamic fracture as an effect of laser induced shock waves.** Salzmann, D.; Gilath, I.; Dariel, M.; Kornblit, L.; Bar-Noy, T. (Israel Atomic Energy Commission, Yavne. Soreq Nuclear Research Center; Ben-Gurion Univ. of the Negev, Beersheba, Israel; Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev). 1986. NTIS (US Sales Only), PC A03/MF A01. File Number DE87780149. (CONF-8606316—Absts.).

From 6. Mach reflection symposium; Beer Sheva, Israel (29 Jun 1986).

42679 (INIS-mf—10918, pp 44) **Numerical simulation of high power, single-pulse, laser beam interaction with targets.** Bar-Noy, T.; Kaufman, Y.; Metzner, N.; Shvarts, D. (Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev). 1986. NTIS (US Sales Only), PC A03/MF A01. File Number DE87780149. (CONF-8606316—Absts.).

From 6. Mach reflection symposium; Beer Sheva, Israel (29 Jun 1986).

42680 (INIS-mf—10922) **Scattering of atomic and molecular ions from single crystal surfaces of Cu, Ag and Fe.** Zoest, J.M. van. (Rijksuniversiteit Utrecht (Netherlands)). 16 Jun 1986. 178p. NTIS (US Sales Only), PC A09/MF A01. File Number DE87702789.

This thesis deals with analysis of crystal surfaces of Cu, Ag and Fe with Low Energy Ion scattering Spectroscopy (LEIS). Different atomic and molecular ions with fixed energies below 7 keV are scattered by a metal single crystal (with adsorbates). The energy and direction of the scattered particles are analysed for different selected charge states. In that way information can be obtained concerning the composition and atomic and electronic structure of the single crystal surface. Energy spectra contain information on the composition of the surface, while structural atomic information is obtained by direction measurements (photograms). In Ch.1 a description is given of the experimental equipment, in Ch.2 a characterization of the LEIS method. Ch.3 deals with the neutralization of keV-ions in surface scattering. Two different ways of data interpretation are presented. First a model is treated in which the observed directional dependence of neutralization action of the first atom layer of the surface is presented by a laterally varying thickness of the neutralizing layer. Secondly it is shown that the data can be reproduced by a more realistic, physical model based on atomic transition matrix elements. In Ch.4 the low energy hydrogen scattering is described. The study of the dissociation of H_2^+ at an Ag surface r0230ted in a model based on electronic dissociation, initialized by electron capture into a repulsive (molecular) state. In Ch.5 finally the method is applied to the investigation of the surface structure of oxidized Fe.

42681 (KEK—85-16) **Prospects in synchrotron radiation science in the x-ray region with the next generation storage ring.** Kikuta, S.; Shimomura, O.; Matsushita, T. (eds.). (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Feb 1986. 155p. (In Japanese). NTIS (US Sales Only), PC A08/MF A01. File Number DE87702655.

The research utilizing emitted light in the Photon Factory of National Laboratory for High Energy Physics has become more and more active, and large impact to many research fields. Recently among the users, the demand of a more powerful radiation source arose on the basis of the results of utilization, and there is the indication that it is necessary to construct a new ring toward the synchrotron radiation science of next generation. The construction of a 6 GeV ring is about to begin as the common facility of European countries, and the planning is also in progress in USA. This book is the summary of the results of survey about the perspective of researchers on the research using synchrotron radiation, carried out by Photon Factory confab and National Laboratory for High Energy Physics. The subject was limited to the use of synchrotron radiation in x-ray or hard x-ray region. The expectation to a new ring, a large storage ring of next generation, the static and dynamic structural analysis of crystals and amorphism, the structure of materials under extreme condition, the basic research and application of scattering phenomena, the application to surface science, biology and medicine, and the analysis of materials are described.

42682 (KU-HCOE-FL2-R—85-19) **Formation of ordered Al/sub 3/Li by ion implantation of lithium into aluminium.** Johnson, E.; Johansen, A.; Sarholt-Kristensen, L. (Copenhagen Univ. (Denmark). H.C. Oersted Inst.). 1985. 14p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87752333.

The microstructure of Al-Li surface alloys made by implantation of lithium ions into aluminium targets has been investigated by transmission electron microscopy. The ordered Al/sub 3/Li δ′ phase is formed when the average lithium concentration exceeds proportional to 4 at.%. The δ′ particles formed after room temperature implantation are larger than those formed conventionally in quenched samples.

42683 (KU-HCOE-FL2-R—85-20) **CEMS of Sb/sup +/ implanted stainless steels.** Roy-Poulsen, H.; Johnson, E.; Johansen, A.; Sarholt-Kristensen, L.; Hayashi, H. (Copenhagen Univ. (Denmark). H.C. Oersted Inst.; Niels Bohr Inst., Copenhagen (Denmark)). 1985. 5p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87752332.

Martensitic transformations have been analyzed in a series of antimony implanted austenitic stainless steels using CEMS. The implanted samples contain about 70 vol% martensite, which is considerably more than can be formed conventionally by plastic deformation or cooling below the martensite start temperature. CEM spectra from implantation induced martensite and from martensite formed in conventional processes are virtually identical. In both cases the hyperfine field is proportional to 25 T.

42684 (KU-HCOE-FL2-R—86-4) **Martensitic transformation in ion implanted 17/7 stainless steels.** Hayashi, N.; Johnson, E.; Johansen, A.; Sarholt-Kristensen, L.; Sakamoto, I. (Copenhagen Univ. (Denmark). H.C. Oersted Inst.; Niels Bohr Inst., Copenhagen (Denmark); Electrotechnical Lab., Sakura, Ibaraki (Japan)). 1986. 7p. (CONF-860879—6). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752336.

From International conference on martensitic transformations (ICOMAT-86); Nara, Japan (26 Aug 1986).

Combined application of conversion electron Moessbauer spectroscopy (CEMS) and transmission electron microscopy (TEM) has been used to study effects of implantation in 17/7 austenitic stainless steels. Projectiles of Kr/sup +/, Ar/sup +/, Fe/sup +/ and Ni/sup +/ ions with energy in the range 90-150 keV were used to bombard the sample surfaces. CEMS and TEM analyses show that irrespective of ion species a martensitic α phase is induced after irradiation to fluences larger than 10/sup 20/ ions/m/sup 2/. The γ (fcc)->α (bcc) transformation is most efficient in the case of inert gas (Kr, Ar) implantations. It is concluded that the driving force is mainly due to internal stress developed in the implantation zone.

42685 (KU-HCOE-FL2-R—86-02) **Ion implantation.** Johnson, E. (Copenhagen Univ. (Denmark). H.C. Oersted Inst.). 1986. 55p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87752330.

It is the purpose of the present paper to give a review of surface alloy processing by ion implantation. However, rather than covering this vast subject as a whole, the survey is confined to a presentation of the microstructures that can be found in metal surfaces after ion implantation. The presentation is limited to alloys processed by ion implantation proper, that is to processes in which the alloy compositions are altered significantly by direct injection of the implanted ions. The review is introduced by a presentation of the processes taking place during development of the fundamental event in ion implantation - the collision cascade, followed by a summary of the various microstructures which can be formed after ion implantation into metals. This is compared with the variability of microstructures that can be achieved by rapid solidification processing. The microstructures are subsequently discussed in the light of the processes which, as the implantations proceed, take place during and immediately after formation of the individual collision cascades. These collision cascades define the volumes inside which individual ions are slowed down in the implanted targets. They are not only centres for vigorous agitation but also the sources for for-

mation of excess concentrations of point defects, which will influence development of particular microstructures. A final section presents a selection of specific structures which have been observed in different alloy systems. (orig./GSCH).

42686 **(KU-HCOE-FL2-R—86-03) Moessbauer and TEM study of martensitic transformations in ion implanted 17/7 stainless steel.** Johnson, E.; Johansen, A.; Sarholt-Kristensen, L.; Graabaek, L.; Hayashi, N.; Sakamoto, I. (Copenhagen Univ. (Denmark). H.C. Oersted Inst.; Electrotechnical Lab., Sakura, Ibaraki (Japan)). 1986. 25p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87752334.

It has earlier been shown that implantation of antimony into austenitic stainless steels induces martensitic phase transformations γ (fcc)->α (bcc). In the present work we have investigated which mechanisms are responsible for the transformation. Samples of 17/7 steels were implanted with noble gases (Kr, Ar) or the stainless steel constituent elements (Fe, Ni, Cr). The energies were selected to give ranges proportional to 40 nm. The phases present after implantation and the microstructures of the implanted samples were studied by CEMS and TEM respectively. A martensitic (α) phase was found to form after implantation both with Ni, Fe and Cr, in spite of the fact that these elements have opposite tendencies for stabilization of the austenite (γ) phase. The efficiency of martensite formation is therefore mainly related to stress relief associated with secondary radiation damage. This was substantiated from the noble gas implantations, where the highest degree of transformation was observed for fluences where bubble formation occurs. The CEMS analyses show that the transformation efficiency in such cases is nearly 100%. The hyperfine parameters of the implantation induced α phase are similar to those from conventionally induced martensites.

42687 **(LAFI—094) Moessbauer diffraction in Si monocrystal at high-frequency ultrasonic excitation. Bragg geometry.** Gavrilov, V.N.; Zolotoyabko, Eh.V.; Iolin, E.M. (AN Latvijskoj SSR, Riga. Inst. Fiziki). 1986. 24p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702845.

The influence of high-frequency ultrasound (US) on the dynamical diffraction of Moessbauer gamma-quanta in the perfect Si single crystal is studied. The dependence of the coherent scattering intensities on the US amplitude, as well as the diffractional Moessbauer spectra for different reflections above and below the threshold frequency ν/sub th/ have been measured. Above the threshold (ν/sub s/ > ν/sub th/) the enhancement of the elastic scattering is observed. At ν/sub s/ < ν/sub th/, pumping of the elastic component into the inelastic one takes place. The problem of Moessbauer diffraction in Bragg case at US excitaton has been theoretically solved. At ν/sub s/ > ν/sub th/ there are bound states of gamma-quanta and US phonons responsible for the observed increase of the elastic scattering. The amplitude dependences of the additions to the elastic and inelastic scattering components have been calculated. The experimental data agree well with the theoretical calculations. 13 references, 10 figures.

42688 **(LBL—23523) Backscattering Moessbauer spectrum and specimen thickness.** Mei, Zegun. (Lawrence Berkeley Lab., CA (USA)). May 1987. Contract AC03-76SF00098. 69p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87012892.

Based on the Bara-Jaggi's mathematical theory of γ-ray backscattering Moessbauer spectrum for finite thickness specimen, the criterion for occurrence of negative amplitude Moessbauer spectrum is derived as $1/(1 + \alpha)$ less than U/sub s//U. This implies that negative amplitude Moessbauer spectrum is very much more likely to occur for the case when the Moessbauer elements are in the matrix materials with very low atomic number Z (Li, Be, and C). The backscattering Moessbauer spectra collected on the Be specimen with Fe impurity proves the existence of negative amplitude Moessbauer spectrum. Parallel to Bara-Jaggi's theory, a new mathematical theory on the conversion x-ray Moessbauer spectrum has been derived. The numerical calculation based on that theory predicts a non-monotonic saturation of the peak amplitude of conversion x-ray backscattering Moessbauer spectrum with specimen thickness, just as Bara-Jaggi's theory did for the γ-ray Moessbauer spectrum. The conversion Moessbauer spectra collected on Fe for the specimens with a range of thickness showed that the peak amplitude saturated with the specimen thickness non-monotonically.

42689 (ZfI—64, pp 18-19) **KANP - simulation of surface contour evolution under vertical ion bombardment.** Nickel, A. Dec 1986. NTIS (US Sales Only), PC A03/MF A01. File Number DE87702867.

In Computer codes for problems of isotope and radiation research.

42690 (ZfI—64, pp 20) **UE6 - program for parameter estimation in bloch equations.** Hirsch, K. Dec 1986. NTIS (US Sales Only), PC A03/MF A01. File Number DE87702867.

In Computer codes for problems of isotope and radiation research.

42691 **Ultraviolet photoelectron spectroscopy of sputter-formed Re-1% Pd.** Gordon, R.L. (Pacific Northwest Laboratory, P. O. Box 999, Richland, Washington 99352). *Journal of Applied Physics;* **62**: No. 5, 2033-2038(1 Sep 1987). Contract AC06-76RL01830.

Ultraviolet photoelectron spectroscopy has been used to obtain electron energy distribution curves (EDC's) from samples of a Re-1% Pd alloy formed by high-rate sputter deposition. The shape of He-I-induced EDC's was found to depend on surface concentration of Pd. For surfaces with Pd/Re<0.014 the EDC is nearly identical to that of a pure Re reference sample and shows structure attributable to the calculated rhenium density of states. With Pd/Re>0.28 the EDC shows reduced occupation in states near the Fermi level, and exhibits a peak at 2.3 eV below the Fermi level, characteristics of the EDC from a clean Pd reference sample. The EDC from the Pd-covered alloy surface cannot be duplicated by a simple linear superposition of EDC's from Re and Pd reference samples. The increase in occupation of the 2.3-eV level at the expense of higher-lying levels in both pure Re and in the low-Pd-coverage alloy is thought to be responsible for the increase in work function of the alloy which accompanies segregation of Pd to the surface.

42692 **Phonon-assisted hopping of an electron on a Wannier-Stark ladder in a strong electric field.** Emin, D.; Hart, C.F. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Physical Review* [*Section*] *B: Condensed Matter;* **36**: No. 5, 2530-2546(15 Aug 1987).

With the application of a spatially constant electric field, the degeneracy of electronic energy levels of geometrically equivalent sites of a crystal is generally lifted. As a result, the electric field causes the electronic eigenstates of a one-dimensional periodic chain to become localized. In particular, they are Wannier-Stark states. With sufficiently large electric-field strengths these states become sufficiently well localized that it becomes appropriate to consider electronic transport to occur via a succession of phonon-assisted hops between the localized Wannier-Stark states. In this paper, we present calculations of the drift velocity arising from acoustic- and optical-phonon-assisted hopping motion between Wannier-Stark states. When the intersite electronic transfer energy is sufficiently small so that the Wannier-Stark states are essentially each confined to a single atomic site, the transport reduces to that of a small polaron. In this regime, while the drift velocity initially rises with increasing electric field strength, the drift velocity ultimately falls with increasing electric-field strength at extremely large electric fields. More generally, for common values of the electronic bandwidth and electric field strength, the Wannier-Stark states span many sites. At sufficiently large electric fields, the energy separation between Wannier-Stark states exceeds the energy uncertainty associated with the carrier's interaction with phonons. Then, it is appropriate to treat the electronic transport in terms of phonon-assisted hopping between Wannier-Stark states. The resulting high-field drift velocity falls with increasing field strength in a series of steps. Thus, we find a structured negative differential mobility at large electric fields.

42693 **Physics of metal clusters.** Cohen, M.L.; Chou, M.Y.; Knight, W.D.; de Heer, W.A. (Lawrence Berkeley Lab., CA). *Journal of Physical Chemistry;* **91**: No. 12, 3141-3149(4 Jun 1987). Contract AC03-76SF00098.

The theoretical and experimental basis for some current physical models are described and applied to explain the properties of clusters of a few prototype s-p metals. Emphasis is given to the successful use of models such as jellium which were originally developed for bulk solids. It is shown that the experimental data and the results of the jellium model point to a shell model description of metal clusters.

6561 Superconductivity

REFER ALSO TO CITATION(S) 41291, 41357, 41366, 41392

42694 **(BNL—39911) Mechanisms of organic superconductivity.** Emery, V.J. (Brookhaven National Lab., Upton, NY (USA); IBM Research Lab., Zurich (Switzerland)). 1986. Contract AC02-76CH00016. 6p. (CONF-8608146—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE87011294.

From Low-dimensional conductors and superconductors; Quebec, Canada (24 Aug 1986).

A model of organic superconductors is based on pairing involving electrons on different organic stacks and take into account the second band of hole states.

42695 **(DOE/ER/03274—8) Studies of relativistic heavy ion collisions: Annual progress report, August 1, 1986-July 15, 1987.** Madansky, L. (Johns Hopkins Univ., Baltimore, MD (USA)). 14 Jul 1987. Contract AC02-76ER03274. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012457.

New results from the Dilepton Spectrometer at LBL and the projected program for the future are reported. The analysis for the single lepton experiment is updated. In addition, the results from experiments on lambda polarization with polarized protons are given, along with preliminary results from a test for a similar experiment using Si projectiles at the AGS. Finally, a review of recent results on subthreshold kaon production from our 1986 runs is added.

42696 **(IC—86/270) Some electronic factors influencing superconductivity in some rare-earth-like elements and the beginning of rare-earth series.** Zhang Liyuan. (International Centre for Theoretical Physics, Trieste (Italy)). Oct 1986. 6p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702582.

In this paper the authors point out some general trends in some electronic factors of rare-earth-like and rare-earth series, which are related to superconductivity. 10 references, 1 table.

42697 **(INIS-mf—10924) UPt_3, heavy fermions and superconductivity.** Visser, A. de. (Amsterdam Univ. (Netherlands)). 3 Dec 1986. 186p. NTIS (US Sales Only), PC A09/MF A01. File Number DE87702791.

In this thesis an experimental study is presented of one of the heavy-fermion superconductors: UPt_3 (T/sub c/=0.5 K). The normal-state properties of this material are governed by pronounced spin-fluctuation effects. The unusual coexistence of spin-fluctuations and superconductivity is strongly suggestive for an unconventional type of superconductivity, mediated by spin-fluctuations instead of phonons, with the condensate formed out of odd-parity electron states. In the first chapter a general introduction is given to the field of the heavy-fermions. In the second chapter a theoretical background for the properties of UPt_3 is presented. Chapter 3 deals with the sample preparation and measuring techniques. In chapter 4 a series of experiments is presented on the normal-phase of UPt_3, among which are studies of the specific heat, thermal expansion, sound velocity, magnetization, electrical resistivity, magnetoresistivity and magnetostriction. Also the influence of high-magnetic fields (35 T) and high-pressures (5 kbar) has been studied. The superconducting phase of UPt_3 has been discussed in chapter 5. In chapter 6 a series of pseudobinary U(Pt/sub 1-x/Pd/sub x/)/sub 3/ compounds ($x \leqq 0.30$) are studied. In the last chapter some final remarks and conclusions are presented. 202 references, 92 figures, 20 tables.

6570 Theoretical And Mathematical Physics

REFER ALSO TO CITATION(S) 41619, 41855, 42316, 42337, 42378, 42464, 42508

42698 **(CBPF-NF—006/86) Features of a relativistic space-time with seven isometries.** Reboucas, M.J.; Teixeira, A.F.F. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1986. 21p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702664.

Previous works on the Reboucas-Tiomno spacetime are extended. It is shown that the RT model is Petrov type 0 and exhibit its conformally flat form. The geodesic equations are fully integrated and corresponding motions are discussed at lenght. Confrontation with other rare solutions possessing seven isometries is made.

42699 **(EFI—836(63)-85) Suppression of transparency effect and investigation of particle reflection from asymmetric potential well.** Atsagortsyan, K.Z.; Gevorgyan, L.A. (Erevanskij Fizicheskij Inst. (USSR)). 1985. 28p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. File Number DE87702687.

The particle one-dimensional motion in the field of asymetric potential Poschi-Teller well is considered. The particle total passage effect is shown to be suppressed at the particle energies as distinct from symmetric well. The reflection coefficient grows with increasing the well symmetry, while at the particle high energies its exponential decrease is replaced versus energy by the power-law dependence. A dispersion is obtained and energy spectrum is found for the particle bound states. The influence of the potential asymmetry on the shape of the particle wave functions is investigated. The analytical conclusions are illustrated by a numerical calculations at various values of the problem parameters. 2 references, 5 figures.

42700 **(EFI—840(66)-85) Confinement problem.** Savvidi, G.K. (Erevanskij Fizicheskij Inst. (USSR)). 1985. 12p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702690.

Such a viewpoint is proposed for separation of the physical quantities into observable and unobservable ones, when the latters are connected with the Hermitian operator for which the eigenvalue problem is unsolvable.

42701 **(EFI—865(16)-86) Problem of Monte-Carlo modeling of physical systems.** Savvidi, G.K.; Ter-Arutyunyan-Savvidi, N.G. (Erevanskij Fizicheskij Inst. (USSR)). 1986. 14p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702706.

Kolmogorov-Anosov-Sinai multidimensional K- and Y-systems are proposed to use as generators of pseudorandom numbers for the statistical computer-modeling by the Monte-Carlo method.

42702 **(IAE—4150/1) Special functions of mathematical physics.** Nikiforov, A.F.; Suslov, S.K. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1985. 43p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. File Number DE87702718.

Special functions of mathematical physics: classical orthogonal polynomials, spherical cylindrical and hypergeometric functions, are considered from a uniform viewpoint. Generalization is made, which permits to include classical orthogonal polynomials of discrete variable in the scheme suggested. Applications of special functions in quantum mechanics are discussed. 37 references, 2 tables.

42703 **(IC—86/142) Prolongation structure and Backlund transformation for new non-linear Klein-Gordon equations.** Roy Chowdhury, A.; Mukherjee, J. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1986. 10p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702567.

The authors have considered the complete integrability of two nonlinear equations which are some kind of extensions of usual Sine-Gordon and Sinh-Gordon equations. The first one is of non-autonomous version of Sinh-Gordon system and the second is closely related to the usual Sine-Gordon theory. The first problem indicates how (x,t) dependent non-linear equations can be treated in the prolongation theory and how a Backlund map can be constructed. The second one is a variation of the usual Sine-Gordon equation and suggests that there may be other equations (similar to Sine-Gordon) which are completely integrable. In both cases the authors have been able to construct the Lax pair. The authors then construct an auto-Backlund map by following the idea of Konno and Wadati, for the generation of multisolution states. 5 references.

42704 **(IC—86/218) Fixed point theorems for paracompact convex sets.** Jiang Jiahe. (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1986. 12p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702573.

In the present paper a few fixed point theorems are given for upper hemi-continuous mappings from a paracompact convex set to its embracing space, a real, locally convex, Hausdorff topological vector space. 9 references.

42705 **(IC—86/255) Computational applications of the thermodynamic local potential: the case of pattern forming systems.** Hubert, J.Z. (International Centre for Theoretical Physics, Trieste (Italy)). Sep 1986. 7p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702577.

Using the thermodynamic local potential PHI a single variational principle may be formulated for a broad class of pattern formation phenomena (this class contains patterns which are: macroscopic, possess steady states, are degenerate at least with respect to one parameter, approach the steady state via fluctuations in the coarsely grained (macroscopic) phase space and so have no memory of the initial conditions). When a steady state is reached PHI assumes its minimum value with respect to distribution function and a maximum with respect to the actually assumed values of free parameters. 10 references, 1 figure.

42706 **(IC—86/278) Basic concepts of Finslerian geometry.** Misra, R.B. (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1986. 37p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87702586.

This paper treats some aspects of the fundamental theory of Finsler manifolds, with special emphasis on the covariant differentiation related to the Euclidean connection of Cartan and of Berwald. 122 references.

42707 **(IC—86/280) Note on the super AKNS equations.** Li Yishen; Zhang Lining. (International Centre for Theoretical Physics, Trieste (Italy)). Oct 1986. 8p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702587.

The authors find some relationships between the usual AKNS scheme with the super one, when its elements take value from the Grassmann algebra on a two-dimensional vector space. The solutions of these super AKNS equations are discussed. 8 references.

42708 **(IC—86/282) Theory of the Franz-Keldysh effect in quantum wells.** Trallero Giner, C. (International Centre for Theoretical Physics, Trieste (Italy)). Sep 1986. 24p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702588.

The authors use the effective-mass approximation to obtain the imaginary part, ϵ_2, of the dielectric constant of a quantum well in an applied electric field for direct transitions at a normal (M/sub O/) threshold. The calculations of ϵ_2 are used to evaluate the real part, ϵ_1, of the dielectric constant through the Kramers-Kronig relations. The changes in ϵ_1 and ϵ_2 due to the electric field are expressed in terms of the corresponding electrooptic functions. All magnitudes are obtained, neglecting excitonic effects, for electric fields both perpendicular to and in the plane of the layers. It is shown that for fields parallel to the layers the electrooptic functions turn out to be a superposition of two-dimensional Franz-Keldysh ones. The electrooptic functions for fields perpendicular to the layers show a qualitatively different behaviour from those observed in bulk semiconductors. Analytic expressions for the Lorentzian broadening of ϵ_1 and ϵ_2 are given in terms of complex valued electrooptic functions of complex argument. 21 references, 2 figures.

42709 (JINR—D-10-11-84-818, pp 258-260) **Polysheroidal periodic functions.** Truskova, N.F. 1985. (In Russian). NTIS (US Sales Only), PC A16/MF A01. File Number DE87780164. (CONF-8309402—).

From 5. international meeting on problems of mathematical simulation, programming, and mathematical methods for solving the physical problems; Dubna, USSR (20 Sep 1983).

Separation of variables in the Helmholtz N-dimensional ($N \geqq 4$) equation in polyspheroidal coordinate systems leads to the necessity of solving equations going over into equations for polyspheroidal periodic functions used for solving the two-centre problem in quantum mechanics, the three-body problem with Coulomb interaction, etc. For these functions the expansions are derived in terms of the Jacobi polynomials and Bessel functions. Their basic properties, asymptotics are considered. The algorithm of their computer calculations is developed. The results of numerical calculations are given. 11 refs.

42710 **(JINR-R—2-86-431) Exact solution to the Kibler-Ronveaux-Negadi problem.** Mardoyan, L.G.; Pogosyan, G.S.; Ter-Antonyan, V.M.; Sisakyan, A.N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1986. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702828.

The problem is exactly solved for expansion of the parabolic and spherical bases of a hydrogen atom over bases of a four-dimensional isotropic oscillator. The results are expressed in terms of tabulated Clebsch-Gordon coefficients of SU(2) group and the Wigner function. 13 references.

42711 **(JINR-R—4-86-339) Trajectories of the collinear Newton three-particle system with zero total energy and total momentum.** Fiziev, P.P.; Fizieva, Ts.Ya. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1986. 14p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702831.

The basic properties of the class of special functions giving the trajectories of the problem of three classical particles are studied. Singular points are found in the complex range of variable values: 46 fixed singular points (taking into account their multiplicity) and moving critical poles. In the real region a variety of solutions is diffeomorphic to a two-dimensional torus on which 24 singular fixed points are placed. A qualitative theory of trajectories and a global phase picture on a torus are constructed. Two types of representations of an additional problem integral are found in the case considered and it is shown to be an infinite-valued function. It is established that the solutions have a critical essential singular poit at zero for every particle mass, which indicates a singular nature of perturbation theory in small mass in the three-particle problem according to the Poincare results and others. 19 references, 3 figures.

42712 **(UFPB-DF—02/86) Linearization of the Hamilton-Jacobi equation.** Espindola, M.L.; Espindola, O.; Teixeira, N.L. (Paraiba Univ., Joao Pessoa (Brazil). Dept. de Fisica). 1986. 4p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702660.

Through a canonoid transformation the integration for the Hamilton-Jacobi equations is transformed into a two step procedure: the first being a linear problem and the second a quasi-linear one. Examples are given.

42713 **(UFPB-DF—03/86) Note on squeezed states.** Pedrosa, I.A.; Baseia, B. (Paraiba Univ., Joao Pessoa (Brazil). Dept. de Fisica). 1986. 5p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702859.

New operators, explicitly time-dependent are introduced and it is shown that their associated states are squeezed states. Also, it is shown that these operators allow one to connect squeezed states with the Bateman Hamiltonian.

42714 **Self-organized criticality: An explanation of the 1/f noise.** Bak, P.; Tang, C.; Wiesenfeld, K. (Physics Department, Brookhaven National Laboratory, Upton, New York 11973). *Physical Review Letters;* **59**: No. 4, 381-384(27 Jul 1987). Contract AC02-76CH00016.

We show that dynamical systems with spatial degrees of freedom naturally evolve into a self-organized critical point. Flicker noise, or 1/f noise, can be identified with the dynamics of the critical state. This picture also yields insight into the origin of fractal objects.

70 FUSION ENERGY

REFER ALSO TO CITATION(S) 42883

42715 **(UCRL—50016-86-2) Mechanical Engineering Technical Abstracts for the period July-December 1986.** Woo, H.H. (ed.). (Lawrence Livermore National Lab., CA (USA)). Apr 1987. Contract W-7405-ENG-48. 54p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87012308.

Twice a year Mechanical Engineering at the Lawrence Livermore National Laboratory publishes Technical Abstracts to inform readers of the broad range of technical activities conducted in the discipline, and to promote an exchange of ideas. This report covers the period July through December 1986 and contains 113 abstracts. Details of the work covered by an abstract may be obtained by contacting the author(s). Each abstract is identified by a report number. Most abstracts are taken from a published document: a Laboratory report, journal article, or meeting paper. However, some abstracts in this report are the sole extent of the published work and, therefore, do not represent the contents of any other, larger work. Some abstracts have received additional editing to meet specific requirements of the present document.

7001 Plasma Research

REFER ALSO TO CITATION(S) 41690, 42347, 42775, 42827, 42895

42716 **(DOE/ER/13449—7) Investigation of parameters critical to muon-catalyzed fusion: Annual performance report, 1986-1987.** Jones, S.E.; Palmer, E.P.; Thorne, J.M.; Mueller, B.; Rafelski, J.; Anderson, A.N. (Brigham Young Univ., Provo, UT (USA); Frankfurt Univ. (Germany, F.R.). Inst. fuer Theoretische Physik; Trois Torrents (Switzerland); Idaho Research, Inc., Idaho Falls (USA)). 19 May 1987. Contract FG02-85ER13449. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010652.

It has been demonstrated (in conjunction with our colleagues) that muon catalysis cycling rates increase rapidly with increasing deuterium-tritium gas temperatures and densities. Furthermore, muon-capture losses are significantly smaller than predicted before the experiments began, although recent theoretical work narrows the gap between theory and observation. As a result of these effects, it was possible to achieve muon-catalyzed fusion yields of 150 fusions/muon (average). The fusion energy thereby released, nearly 3 GeV/muon, significantly exceeds theoretical expectations, and still higher yields are expected. Therefore, the limits of muon-catalyzed fusion are being explored to provide answers to questions regarding energy applications of muon-catalyzed fusion.

42717 **(DOE/ER/53193—7) Thermal and particle transport in tokamaks: Theoretical models for ignition studies.** Ross, D.W.; Diamond, P.H.; Drake, J.F.; Hinton, F.L.; Perkins, F.W.; Tang, W.M.; Waltz, R.E.; Zweben, S.J. (Texas Univ., Austin (USA). Fusion Research Center). Jun 1987. Contract AS05-85ER53193. 55p. (FRCR—295). NTIS, PC A04/MF A01; GPO Dep. File Number DE87012232.

The panels on electron and ion thermal transport theory of the Ignition Physics Study Group (IPSG) have recommended that theoretically based models of anomalous transport be used to investigate ignition regimes of tokamak plasmas, and that related studies of fluctuations and transport, both experimental and theoretical, in present devices continue to be pursued vigorously. This report begins the implementation of this recommendation by discussing theoretically based transport coefficients for use in simulations and directions for experimental studies aimed at verifying the corresponding theories. This work is intended to be complementary to that of the corresponding panels on modelling and experimental confinement and scaling. 96 refs.

42718 **(DOE/ER/53212—108) Theoretical reversed field pinch studies: Technical progress report for the period September 1, 1986-August 31, 1987.** Prager, S.C. (Wisconsin Univ., Madison (USA)). 1987. Contract FG02-85ER53212. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87012045.

This report gives information on research dealing with plasma stability in a reverse-field pinch device. Analytic and numerical calculations on various stability phenomena have been performed. (JDH)

42719 **(GA-A—18836) Avoidance of cyclotron breakdown in partially evacuated waveguides.** Moeller, C.P. (GA Technologies, Inc., San Diego, CA (USA)). Apr 1987. Contract AC03-84ER51044. 11p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87012304.

Cyclotron breakdown in a partially evacuated waveguide which passes through a resonant magnetic field can be suppressed by application of a transverse electrostatic field. A practical system for accomplishing this and experimental tests of the concept are described.

42720 **(GA-A—18861) Third-harmonic electron cyclotron heating for tokamak high-beta profile control studies.** Simonen, T.C.; Matsuda, K.; Prater, R.; Smith, G.R. (GA Technologies, Inc., San Diego, CA (USA)). May 1987. Contract AC03-84ER51044;W-7405-ENG-48. 7p. (CONF-870570—19). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011834.

From 7. topical conference on applications of radio-frequency power to plasmas; Kissimmee, FL, USA (4 May 1987).

Third-harmonic extraordinary-mode ECH could be employed for D III-D high-beta studies at reduced toroidal magnetic field. D III-D neutral beam injection increases the electron temperature above 4 keV. At 4 x 10^{19} m^{-3} density, the third-harmonic 120 GHz ECH power should be absorbed with greater than 80% efficiency. Absorption would increase at higher temperature unless the distribution function is too severely distorted by the high-power ECH. A 6 MW-120 GHz system could thereby allow well-controlled beta and profile control studies using third-harmonic ECH.

42721 **(GA-A—18864) H-mode investigations in DIII-D.** Shimada, M.; Burrell, K.H.; Ejima, S.; Schissel, D.P.; Allen, S.; Brooks, N.H.; Bramson, G.; Callis, R.W.; Carlstrom, T.N.; Colleraine, A.P. (GA Technologies, Inc., San Diego, CA (USA); Japan Atomic Energy Research Inst., Tokai, Ibaraki; Lawrence Livermore National Lab., CA (USA); Johns Hopkins Univ., Baltimore, MD (USA); Hitachi Ltd., Ibaraki (Japan); Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). May 1987. Contract AC03-84ER51044. 7p. (CONF-870629—9). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011833.

From 14. European conference on controlled fusion and plasma physics; Madrid, Spain (22 Jun 1987).

DIII-D is a large tokamak (major radius R = 1.67 m, minor radius a = 0.67 m), capable of producing vertically elongated limiter and divertor plasmas with high plasma current at modest toroidal field (B/sub T/ = 2.2 T on axis). To date, maximum plasma currents achieved are 3.0 MA in limiter plasmas (elongation in excess of 2.0), 2.0 MA in divertor plasmas (elongation 1.9). The DIII-D divertor is a reactor-compatible open divertor design, with no separate divertor chamber and no coils in vacuum. The divertor plates are two toroidal bands of carbon tiles on the bottom of the vacuum vessel. Deuterium plasmas are heated by hydrogen neutral

beams (75 keV, coinjection only) and electron cyclotron heating / 1/. Power levels to date are 6 MW (beam) and 1.0 MW (ECH). H-mode discharges, H-mode thresholds, and Edge Localized Modes have been investigated for this system.

42722 **(IAE—4168/6) Drift-cone and drift-cyclotron instabilities. Review of the linear theory.** Timofeev, A.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1985. 15p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702719.

Basic results obtained for adiabatic traps when studying drift-cone and drift-cyclotron instabilities in the linear approximation are reviewed. 15 references, 5 figures.

42723 **(IAE—4170/7) Plasma heating in large tokamaks by means of magneto-acoustic waves with Alfven resonance.** Vdovin, V.L. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1985. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702720.

A theory of plasma heating in tokamaks by magnetoacoustic waves at the frequencies below ion-cyclotron one is developed in the pape. Under these conditions alfven resonance region varying significantly fast magnetoacoustic wave (FHAW) dissipation is present in plasma. The parameter choice being suitable, dissipation may disappear allowing for existence of high Q intrinsic toroidal modes in large T-10, T-15 type tokamaks, that appreciably simplifies excitation system in comparison with the design necessary for heating by means of pure alfven wave. 3 references.

42724 **(IAE—4173/6) Hydrodynamics of neutral component in a divertor plasma.** Krasheninnikov, S.I.; Pozharov, V.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1985. 20p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702721.

Hydrodynamic equations describing neutral component atomic fraction dynamics in tokamak poloidal divertor are obtained. Results of numerical calculations of simulating plasma behaviour in divertor are presented. At sufficiently high heat fluxes in divertor existence of ambiguous solutions related to the character of energy losses in plasma is shown to be possible. Calculation results are in agreement with the analytical model. 12 references, 9 figures.

42725 **(IAE—4185/7) Calculation-theoretical analysis of two-dimensional flows of a substance under laser-radiation heating.** Bol'shov, L.A.; Kiselev, V.P.; Taran, M.D.; Yudin, A.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1985. 24p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702722.

The calculation-theoretical analysis of one- and two-dimensional flows of a substance under laser heating of plane aluminium targets with account of the real equation of state and plasma X-radiation is conducted. Efficiency of laser radiation energy conversion to kinetic energy of the target has been studied. 19 references, 15 figures.

42726 **(IAE—4194/7) Tearing instability at the T-13 tokamak.** Bortnikov, A.V.; Brevnov, N.N.; Gerasimov, S.N.; Makashin, I.N.; Tsepakin, I.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1985. 15p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702723.

Experimental results of tearing instability investigation at T-13 tokamak are given. Instability was observed under such conditions, when plasma filament could move freely along a large radius. Multichannel measuring system Sapphire-2, comprising a microcomputer, multichannel digital recorder, recorder on the base of multichannel device for accurate magnetic recording, was used for data ecquisition and for accumulation and archiving of experimental data. 18 references, 12 figures.

42727 **(IAE—4217/8) Near-wall plasma description in the frames of one-dimensional self-matched model with the presence of impurities.** Igitkhanov, Yu.L.; Pistunovich, V.I.; Pozharov, V.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1985. 56p. (In Russian). NTIS (US Sales Only), PC A04/MF A01. File Number DE87702725.

Physical processes in near-wall plasma of a tokamak with poloidal magnetic divertor is investigated. In the frames of one-dimensional hydrodynamic equations of longitudinal energy and particle transfer are stationary distributions of plasma parameters in a divertor layer and in divertor volume with the presence of impurity atoms flux from divertor plate surfaces due to ion sputtering. Self-matched plasma and impurity model consideration permits to determine impurity real level in considered divertor regimes, to investigate their spatial effect on the value of plasma parameters in divertor. Numerical calculations are compared with the data obtained at ASDEX device. 32 references, 6 figures.

42728 **(IAE—4225/10) Mathematical modelling technique application for plasma spectroscopy.** Lazarenko, Yu. V.; Povolotskaya, G.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1985. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702727.

Mathematical modelling technique application to plasma spectroscopy, in particular, to determination of ion and electron temperature, electron concentration, the background calculation is described. Methods of numerical experiments confirming their reliability are considered. 3 references.

42729 **(IAE—4230/7) /sup D/rakon¯ closed trap with large β ratio.** Artemenkov, L.I.; Volkov, T.F.; Glagolev, V.M.; Dobryakov, A.V.; Leneva, A.E.; Mukhin, P.A.; Trubnikov, B.A.; Shatalov, G.E. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1985. 35p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. File Number DE87702728.

The problems of equilibrium, stability, thermal conductivity of plasma in the magnetic trap Drakon are considered. The parameters of the thermonuclear reactor Drakon are estimated, the experimental program is suggested. The magnetic trap consists of two rectilinear sections and two curvilinear elements (CE). The CE parameters are selected to ensure more equilibrium plasma pressure in rectilinear sections ($\beta \simeq 0.4$-0.5) with sufficient length of these sections the above β value is characteristic of the whole system. The above theoretical calculations and estimations show that Drakon possesses principle advantages over other stationary thermonuclear systems systems. 24 references, 15 figures, 6 tables.

42730 **(INIS-BR—649) About numerical analysis of a plasma physics problem.** Almeida Cipolatti, R. de. (Santa Catarina Univ., Florianopolis (Brazil)). 1985. 6p. (In Portuguese). (CONF-8509403—1). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702758.

From 8. national congress on applied and computational mathematics; Florianopolis, Brazil (16 Sep 1985).

A numerical study on macroscopic equilibrium of a plasma at interior of a tokamak device, considering boundary problems for the case which f(s)=sis presented. The abstract Dirichlet problem enumerating main results which is applied to plasma model is studied. (M.C.K.).

42731 **(INIS-BR—652) Technical report- Group of Plasma.** Sakanaka, P.H.; Boeckelmann, H.K.; Marotta, A. (Universidade Estadual de Campinas (Brazil). Inst. de Fisica). 1985. 55p. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. File Number DE87702760.

The research activities of Plasma Laboratory at UNICAMP (University of Campinas, Brazil) in the period from November 84 to July/85 are described. In the TUPA project, several works related to substructure and research programs were developed. Diagnostic techniques to analyse the theta Pinch implosion phase, a presure probe, an electrostatic ion energy analyser and laser-produced plasma spectroscopy were developed. The experimental results

were obtained, using multiple magnetic probes inserted in the plasma. These results were analysed by numerical code using some MHD equations in 2 dimensions. A description of plasma dynamic was determined and the plasma parameters such as density and temperature were estimated.

42732 **(IPPCZ—255) Plasma formation and sustainment by a multijunction grill on the CASTOR tokamak.** Nanobashvili, S.; Datlov, J.; Stoeckel, J.; Zacek, F. (Ceskoslovenska Akademie Ved, Prague. Ustav Fyziky Plazmatu). Nov 1985. 17p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702804.

Radiofrequency power up to 40 kW, injected into the vacuum chamber of the CASTOR tokamak by a multijunction grill, was used for plasma production during the ramp-up phase of a toroidal magnetic field. When electron cyclotron resonance (ECR) appears inside the tokamak chamber for the given pumping frequency (f=1.25 GHz) plasma with a density greater than $2x10^{18}$ m^{-3} and a temperature of T/sub e/=10 to 40 eV is produced. The plasma is sustained at some lower value of density during the whole RF pulse. Simultaneously, a toroidal current of up to ≅ 0.2 kA is generated. The energy confinement time is estimated to be about 30 μs during the ECR breakdown.

42733 **(IPPCZ—256) Initial experimental results on a CASTOR tokamak.** (Ceskoslovenska Akademie Ved, Prague. Ustav Fyziky Plazmatu). Nov 1985. 15p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702805.

A new version of the former TM-1-MH tokamak, named CASTOR, was put into operation at the end of 1984. As an initial experiment after the tokamak reconstruction, a study of the start-up discharge phase was carried out. It was shown experimentally that during the inductive breakdown a strongly overthermal plasma potential was generated. Convective losses in the breakdown phase were also measured. Their physical mechanism and that of the generation of the observed electrostatic fields are discussed in the first part of the paper. In the second part, a lower hybrid current drive with a multijunction HF grill is reported. By applying HF power in the lower hybrid region, a HF-driven toroidal current was generated with the efficiency of 1A/W. A quasistationary plasma with a flat radial distribution was sustained during the HF pulse even after short-circuiting the tokamak transformer primary coil.

42734 **(IPPCZ—260) Global energy balance and density limit on CASTOR tokamak.** Dyabilin, K.S.; Badalec, J.; Datlov, J.; Jakubka, K.; Kopecky, V.; Stoeckel, J.; Valovic, M.; Zacek, F.; Borshegovskij, A.A.; Korotkov, A.A. (Ceskoslovenska Akademie Ved, Prague. Ustav Fyziky Plazmatu). Dec 1985. 41p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87702806.

Total radiative power losses were measured with a pyroelectric detector on the CASTOR tokamak in a broad range of plasma parameters. It was shown that while the most important channel of energy losses for the low density operation (average n/sub e/< or approx.=10^{19} m^{-3}) is thermal conductivity, the high density regimes are radiative dominant. Using a simple analytic energy balance model, the connection is discussed between such a high level of radiation and the shrinking of the current channel resulting in an enhanced MHD activity.

42735 **(IPPJ—764) Production of highly relativistic ions and electrons by quasi-perpendicular magnetosonic shock waves.** Ohsawa, Yukiharu. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Jan 1986. 13p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702605.

It is shown that a non-relativistic theory for laminar shocks breaks down for a plasma having a rather high Alfven speed, υ/sub A/ > approx c (m/sub e//m/sub i/)^{1}2/. By using a 2 - 1/2 dimension, fully relativistic, fully electromagnetic particle code, time evolution of quasi-perpendicular shocks in such plasmas is studied. Some ions and electrons are accelerated simultaneously to highly relativistic speeds by the shock.

42736 **(IPPJ—766) Measurement of density fluctuations on the JIPP T-II tokamak plasma by millimeter and sub-millimeter wave scattering.** Tetsuka, Tsutomu. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Feb 1986. 139p. NTIS (US Sales Only), PC A07/MF A01. File Number DE87702606.

Scattering experiments with a 2-mm microwave oscillator (E.I.O.) and a 337-μm HCN laser were performed to measure density fluctuations on the JIPP T-II/T-IIU tokamak in a wide range of the plasma density. It is found from the measurements of the frequency and wavenumber spectra of the instability that the density fluctuation shows characteristics of a turbulence which is originated in the instability of drift type. The dependence of the fluctuation level on the plasma parameters was investigated and compared with the scaling law of the energy confinement time of the plasma. The relation between the density fluctuation level and the confinement time was obtained. The fluctuation level decreases as the electron density is increased. The plasma temperature dependence of the density fluctuation was also investigated. During the rf heating in the ion-cyclotron range of frequency (ICRF) the increase in the density fluctuation level was observed in low-frequency and long-wavelength region. The temporal behavior of the density fluctuation was correlated with the MHD oscillation observed by magnetic probes. The excited wave during the ICRF heating experiment was studied by the HCN laser scattering. The frequency and wavenumber spectra of the excited wave observed during the heating are found to be consistent with the theoretically estimated wave dispersion of the ion Bernstein wave which is mode-converted from the fast wave in the vicinity of the ion-ion hybrid resonance layer. When the MHD activity grows and the plasma becomes unstable, the scattered signal from the ion Bernstein wave decreases, being accompanied with large pulsation.

42737 **(IPPJ—768) Thermal barrier potential of a tandem mirror.** Katanuma, I.; Kiwamoto, Y.; Ishii, K.; Miyoshi, S. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Mar 1986. 45p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87702607.

The relation between the electrostatic potential and the low energy electron density under electron cyclotron resonance heating (ECRH) in the thermal barrier of a tandem mirror is investigated analytically and numerically. The distribution function of mirror trapped electrons at low energy is found to stretch out in the perpendicular direction to the magnetic field and to be well approximated by bi-Maxwellian (T sub(perpendicular) ≧ T sub (parallel)) rather than by Maxwellian. Under the approximation it is found analytically that the conventional Boltzmann law for the barrier depth is modified to another expression including the ratio between T sub(perpendicular) and T/sub e/ (central cell electron temperature). The bounce-averaged Fokker-Planck simulations show that T sub(perpendicular)/T/sub e/ itself is a function of the potential depth and that the Boltzmann law is modified to q(phi/sub b/ - phi/sub e/) = T/sub e/ln(αn/sub c//n/sub b/) with α = 1.5 — 1.8 depending on ECRH power. This expression agrees well with experimental results on GAMMA 10.

42738 (IPPJ—769, pp 188-197) **Stopping power calculation due to Green function's method.** Kitagawa, M. (North Shore College, Atsugi, Japan. Dept. of Electronics). Mar 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87780130. (CONF-8510335—Vol.1).

From Meeting on particle beam fusion and its related problems; Nagoya, Japan (31 Oct 1985).

A dielectric function ε for an inhomogeneous many electron system is calculated under the condition of the high frequency response due to the Green function's method. An inverse dielectric function ε/sup -1/ is formally derived from above ε through the integral equation, in which the space-damping effects of the localized mode are included in the higher order terms of an iteration. Using the lowest order of approximation in the iteration, we can derive and show that the lowest order formula of stopping power exactly corresponds to one called as the local density approximation which is phenomenologically introduced in the theory of stopping power.

42739 **(JAERI-M—86-114) Development of helium beam injection for JT-60 active beam diagnostic system.** Ito, T.; Horiike, H.; Matsuoka, M. (Japan Atomic Energy Research Inst., Tokyo). Aug 1986. 80p. (In Japanese). NTIS (US Sales Only), PC A05/MF A01. File Number DE87702614.

A 200 keV neutral helium beam injector is a major component of the active beam diagnostic system to measure the ion temperature at the center of the JT-60 plasma. Specifications of the ion source required for this injector are: beam energy 200 keV, helium ion current 3.5 A, beam divergence below 0.4 degrees. Such an ion source has not been developed so far in the world. However, the ion source is located on the extrapolating line of technology obtained in the R and D neutral beam injectors for heating, and it was expected that such a source could be developed. To facilitate ion source development, along with adjustment of the power supply and performance test of the beam line components, the injector was installed in a test room in October 1983. The R and D was begun immediately. The desired injector was completed in September 1985 on schedule. In particular, the final results was ion source and extract repeatedly 200 keV, 3.5 A helium beams with an e-folding beam divergence of 0.18 degrees. It is a magnetic multipole type ion source with a three stage accelerator. The achieved performence is more than that of specification. The accuracy of measurement of the JT-60 ion temperature can be increased by this development.

42740 **(JAERI-M—86-156) Nonlinear evolution of free-boundary kink mode in a tokamak.** Kurita, G.; Takizuka, T.; Azumi, M.; Takeda, T. (Japan Atomic Energy Research Inst., Tokyo). Oct 1986. 22p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702636.

Nonlinear MHD calculations of the m/n = 2/1 free-boundary kink mode in a cylindrical tokamak are carried out by taking account of the parallel diffusion of resistivity. The vacuum bubbles inside the plasma are formed for q/sub a/ a little smaller than 2. When 1.75 < q/sub a/ < 1.9 for q_0/q/sub a/ = 0.5 (q_0 is the safety factor at the magnetic axis and q/sub a/ is that at the plasma surface), the plasma column shrinks with the elliptic deformation, the value of q/sub a/ is decreased in time, the plasma becomes stable against the m/n = 2/1 mode, and finally damping oscillation is observed. Interaction between the plasma and material limiter causes the shrinkage for all the unstable values of q/sub a/. When q_0 is nearly equal to or larger than unity, the plasma shrinks rapidly and q/sub a/ can be reduced less than unity below which the m/n = 1/1 kink mode becomes unstable. This plasma shrinkage is a candidate of the major disruptions in the tokamak discharge with q/sub a/ less or equal to 2.

42741 **(JAERI-M—86-171) Numerical computation of FCT equilibria by inverse equilibrium method.** Tokuda, S.; Tsunematsu, T.; Takeda, T. (Japan Atomic Energy Research Inst., Tokyo). Nov 1986. 44p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. File Number DE87702641.

FCT (Flux Conserving Tokamak) equilibria were obtained numerically by the inverse equilibrium method. The high-beta tokamak ordering was used to get the explicit boundary conditions for FCT equilibria. The partial differential equation was reduced to the simultaneous quasi-linear ordinary differential equations by using the moment method. The regularity conditions for solutions at the singular point of the equations can be expressed correctly by this reduction and the problem to be solved becomes a tractable boundary value problem on the quasi-linear ordinary differential equations. This boundary value problem was solved by the method of quasi-linearization, one of the shooting methods. Test calculations show that this method provides high-beta tokamak equilibria with sufficiently high accuracy for MHD stability analysis.

42742 **(JAERI-M—86-172) Data set for benchmark calculation on ideal MHD beta limit of INTOR plasma.** Tsunematsu, T.; Tokuda, S.; Nemoto, T.; Azumi, M.; Takeda, T. (Japan Atomic Energy Research Inst., Tokyo). Nov 1986. 47p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87702642.

Data sets for the benchmark calculations of the ideal MHD beta limit are presented. These data sets are useful for the international collaborations such as INTOR workshop. For the detailed comparison of the results, the documentations of the basic equations and numerical methods are also described.

42743 **(JAERI-M—86-174) Review of JT-60 experiment (April-June, 1985).** (Japan Atomic Energy Research Inst., Tokyo). Nov 1986. 184p. (In Japanese). NTIS (US Sales Only), PC A09/MF A01. File Number DE87702644.

Initial ohmic heating experiments in JT-60 were performed for a three month period of April-June 1985. A maximum plasma current of 1.6 MA was obtained for both divertor and limiter discharges. Low-q discharges of q/sub eff/ = 2.5 and high density discharges of 4.8×10^{19} m^{-3} were obtained in the divertor configuration. Typical divertor actions, i.e., particle exhaust, heat exhaust, impurity reduction and remote radiative cooling were demonstrated.

42744 **(JAERI-M—86-175) Review of JT-60 experiment (March 1986).** (Japan Atomic Energy Research Inst., Tokyo). Nov 1986. 210p. (In Japanese). NTIS (US Sales Only), PC A10/MF A01. File Number DE87702645.

Results of JT-60 experiment with ohmic heating in March 1986 are summarized. A maximum plasma current of 2 MA, an average plasma density of 5.7×10^{19} m^{-3} and energy confinement time of 0.4 - 0.5 sec were obtained. Detailed characteristics of ohmic plasmas are discussed.

42745 (JINR—D-10-11-84-818, pp 169-171) **On the inverse problem in the theory of plasma MHD equilibrium in a tokamak.** Dojnikov, N.I.; Filatov, O.G. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad, USSR). 1985. (In Russian). NTIS (US Sales Only), PC A16/MF A01. File Number DE87780164. (CONF-8309402—).

From 5. international meeting on problems of mathematical simulation, programming, and mathematical methods for solving the physical problems; Dubna, USSR (20 Sep 1983).

An equation describing plasma MHD equilibrium in a tokamak where plasma is confined by discrete turns with current is given. The details of calculation of optimum currents in the turns using the regularization method are discussed. The calculation is based on solving an alternating sequence of inverse and direct problems. It is noted that since the regularization method gives a stable solution currents in the turns calculated by this method are not very sensitive to the plasma current distribution. It is profitable from the viewpoint of reducing the requirements to the system of automatic tokamak control. 5 refs.

42746 (JINR—D-10-11-84-818, pp 195-197) **Mathematical simulation of multicomponent plasma composition.** Shirkov, P.D. (Moskovskij Gosudarstvennyj Univ., USSR). 1985. (In Russian). NTIS (US Sales Only), PC A16/MF A01. File Number DE87780164. (CONF-8309402—).

From 5. international meeting on problems of mathematical simulation, programming, and mathematical methods for solving the physical problems; Dubna, USSR (20 Sep 1983).

The statement and solution of the problem of mathematical simulation of the composition of chemically reacting, dissociating and ionizing plasma being in local thermodynamic equilibrium are considered. While solving the problem the split models based on an assumption that the composition of the medium being studied is formed in the successive independent chemical reactions are used. To define the medium particle concentration more accurately a simple iterative procedure quickly converging to the solution of the desired system of nonlinear algebraic equations describing the equilibrium gas composition is proposed. The equations of balance of charged and neutral particles form the basis of the iterations. 5 refs.

42747 **(Juel—2094) Investigation of neutron spectrometers as fusion plasmas diagnostic methods.** Mobasher, M. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung; Technische Hochschule Aachen (Germany, F.R.)). Nov 1986. 132p. NTIS, PC E11; Available from NTIS as TIB/B87-07808.

Two neutron spectrometer systems were investigated to be used as fusion plasmas diagnostic methods. The first, NE-213 proton recoil spectrometry system has been assembled with two different detector sizes to be used for both D-D and D-T measurements. The detectors' efficiencies and response functions (Response Matrices) were calculated with CECIL Monte Carlo code. Several improvements have been made for this code to agree with the measurements of this spectrometer. Neutron energy spectra were obtained by unfolding the measured pulse height spectra. The FERDOR unfolding procedure after several improvements have been used in unfolding the measured spectra. A second neutron spectrometer using a He-3 semiconductor sandwich detector was used to measure the neutron spectrum for D-D neutrons. The efficiency was calculated and the resolution was determined from the neutron energy spectra. These spectrometers approved to be efficient for fusion plasma diagnostics for temperature $\geqq 1$ keV.

42748 **(LA-UR—87-1929) Diagnostic technique for monitoring high temperature plasma dynamics.** Lumpkin, A.H.; Pappas, D.S. (Los Alamos National Lab., NM (USA)). Jun 1987. Contract W-7405-ENG-36. 17p. (CONF-870622—7). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011786.

From 19. fluid dynamics, plasma dynamics, and laser conference; Honolulu, HI, USA (8 Jun 1987).

A preliminary design for the adaptation of a pinhole experiment (PINEX) technique to the monitoring of the dynamics of high temperature plasmas is described. Specifically, this imaging technique uses a thick aperture, an efficient radiation converter, and highly intensified television cameras to provide real-time viewing of radiation sources such as the neutron emissions from d-d and d-t fusion reactions in controlled thermonuclear research devices. The neutron emission strengths, $R \sim 5 \times 10^{15}$ n/s, recently achieved at the Tokamak Fusion Test Reactor (TFTR) and the Joint European Torus (JET) should be sufficient for 3 to 6-cm spatial resolution and 10 to 100-ms time resolution using such a system. Such information should be useful for on-line optimization of the plasma and for quantitative evaluation of its performance.

42749 **(Rijnhuizen—86-166) Plasma Physics Plotting Library PPPLIB FORTRAN 77 revision.** Goedbloed, J.P.; Hogewey, G.M.D.; Hewett, D.W. (Associatie Euratom-FOM, Nieuwegein (Netherlands). FOM-Instituut voor Plasmafysica). May 1986. 81p. NTIS (US Sales Only), PC A05/MF A01. File Number DE87702857.

The Plasma Physics Plotting Library PPPLIB is described. This library is a FORTRAN 77 revision of the earlier package P4 developed at Los Alamos. Through a new way of dealing with character plotting the present version is completely portable, with a minimum number of system-dependent calls kept in parallel branches for use on the CDC and CRAY computers. Amongst the many new features added are equidistant scaling, dashed line plotting, vector plotting, and some 3D plotting. The report gives a complete set of test programs and contains the full listing of the source.

42750 **(Rijnhuizen—86-169) Systematic control of large computer programs. CCL, UPDATE, and FORTRAN procedures.** Goedbloed, J.P.; Klieb, L. (Associatie Euratom-FOM, Nieuwegein (Netherlands). FOM-Instituut voor Plasmafysica). Jul 1986. 101p. NTIS (US Sales Only), PC A06/MF A01. File Number DE87702858.

A package of CCL, UPDATE, and FORTRAN procedures is described which facilitates the systematic control and development of large scientific computer programs. The package provides a general tool box for this purpose which contains many conveniences for the systematic administration of files, editing, reformating of line printer output files, etc. In addition, a small number of procedures is devoted to the problem of structured development of a large computer program which is used by a group of scientists. The essence of the method is contained in three procedures N, R, and X for the creation of a new UPDATE program library, its revision, and execution, resp., and a procedure REVISE which provides a joint editor - UPDATE session which combines the advantages of the two systems, viz. speed and rigor. 9 references, 5 figures.

42751 **(RISO-M—2563) Some open questions concerning the neutral-shielding model of a fuelling pellet.** Chang, C.T. (Risoe National Lab., Roskilde (Denmark)). Feb 1986. 34p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87752325.

To obtain a better understanding of the implications and assumptions of the idealized neutral shielding model of Parks and Turnbull, the model is reformulated in a self consistent way. Due to the uncertainty of the actual ablation process occuring at the pellet surface, alternative boundary conditions are proposed. Their effect on the pellet ablation rate and the state of the ablated flow are examined by numerical analyses. The results show that the ablation rate is not sensitively affected but the ablatant state is markedly influenced by the boundary condition at the pellet surface. In particular, an increase of the energy flux received at the pellet surface by a factor of four hardly affect the ablation rate but changes the temperature and the density of the ablatant at the pellet surface by three orders of magnitude. Based on these obtained results, it is concluded that the idealized ablation model is adequate when pellet injection is used to fuel a plasma but requires modification when it is used to probe plasma properties and discharge conditions.

42752 **(UCRL—96050) Ion-cyclotron instability in magnetic mirrors.** Pearlstein, L.D. (Lawrence Livermore National Lab., CA (USA)). 2 Feb 1987. Contract W-7405-ENG-48. 30p. (CONF-870247—3). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011546.

From International Rosenbluth symposium on dynamics of particles and plasmas; Austin, TX, USA (2 Feb 1987).

This report reviews the role of ion-cyclotron frequency instability in magnetic mirrors. The modes discussed here are loss-cone or anisotropy driven. The discussion includes quasilinear theory, explosive instabilities of 3-wave interaction and non-linear Landau damping, and saturation due to non-linear orbits. (JDH)

42753 **(UCRL—96819) 3-D hybrid PIC code to model the tilt mode in FRCs.** Horowitz, E.J.; Shumaker, D.E. (Lawrence Livermore National Lab., CA (USA)). Jun 1987. Contract W-7405-ENG-48. 5p. (CONF-870631—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011564.

From 8. US symposium on compact toroid research and the 9. US/Japan workshop on compact toroids; College Park, MD, USA (4 Jun 1987).

The results from QN3D are presented. QN3D is a 3-dimensional hybrid particle-in-cell code designed to run efficiently on the Cray-2 Multiprocessor. The chief application has been to the tilt mode instability in FRCs. QN3D accepts as input, the magnetic field, the ion particle density and the ion temperature on a two-dimensional r-z grid. These quantities are interpolated to the rest of the cartesian grid under the assumption of azimuthal symmetry. The particles are initialized with random numbers chosen according to the particle distributions input from the equilibrium code. The runs done here used equilibria computed by EQV, a kinetic equilibrium code.

42754 **Point radiographic source characterization.** Zigler, A.; Lee, R.W.; Kilkenny, J.D.; Kolbe, G.; Nathel, H. (University of California, Lawrence Livermore National Laboratory, Livermore, California 94550). *Journal of Applied Physics;* **62**: No. 5, 1671-1674(1 Sep 1987). Contract W-7405-ENG-48.

A study was undertaken to find the optimal conditions for generating x rays using a high-power frequency-doubled Nd laser pulse for x-ray backlighting application. More than 30 laser shots on the Lawrence Livermore National Laboratory JANUS Research Laser system have been studied. The following specific questions are addressed: (a) X-ray yield dependence on the laser parameters: (i) temporal pulse width and (ii) focusing conditions. (b) X-ray source size versus target dimensions by using a tungsten wire with various diameters. (c) Influence of background plasma on the x-ray yield from the wire using 25-μm wires surrounded by plastic.

42755 **Radiative and transport properties of ions in strongly coupled plasmas.** Boercker, D.B.; Iglesias, C.A.; Dufty, J.W. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). *Physical Review [Section] A: General Physics;* **36**: No. 5, 2254-2264(1 Sep 1987).

A simple model is proposed for the dynamical effects of a strongly coupled plasma on the center-of-mass and internal coordinates of an ion. The ion is coupled to the plasma through monopole and dipole interactions. The radiative and transport properties of the ion are intimately related since both are governed by the electric microfield at the ion. A unified description of both types of properties is obtained by a formulation focused on the dynamics of the electric microfield. The velocity autocorrelation function, self-structure factor, and electric field correlation function are all in good agreement with computer simulation results, even for strongly coupled plasmas. The effects of perturbing ion motion on Lyman-α and Lyman-β spectral line profiles are calculated. Again, good agreement with computer-simulation results is obtained.

42756 **Computer simulation of a plasma streaming across a magnetic field.** Galvez, M. (Earth and Space Science Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physics of Fluids;* **30**: No. 9, 2729-2739(Sep 1987).

A one-dimensional electrostatic particle simulation code has been used to study a plasma streaming across a uniform magnetic field in vacuum. It is found that the plasma may be convected across the magnetic field even if the density is less than the critical density n/sub c/ necessary to maintain steady propagation. For all densities studied, polarization charge layers are formed, but they do not become steady for plasmas with n/n/sub c/<1. For plasma densities at n$<$n/sub c/, the electric field keeps oscillating with the upper hybrid frequency, but for n/sub c/$<$n, the amplitude of the oscillations are damped at later times. The mechanism that produces this damping is associated with a nonlinear wave—particle interaction. For unequal mass species, the simulations show that the heavier particles are convected faster than the lighter ones; thus the positive particles move in front and the negatives move behind creating a virtual cathode. The polarization charge layers are asymmetric, with the thicker layer corresponding to the heavier particles. This paper also includes simulations of plasma streams with different initial widths. The results of these simulations are that the electric field oscillation shows an earlier damping for narrow plasmas, the charge layer thickness decreases for wider plasmas, and the drift velocity is not sensitive to the plasma width.

42757 **Anisotropic pressure tokamak equilibrium and stability considerations.** Salberta, E.R.; Grimm, R.C.; Johnson, J.L.; Manickam, J.; Tang, W.M. (Princeton University, Plasma Physics Laboratory, P.O. Box 451, Princeton, New Jersey 08544). *Physics of Fluids;* **30**: No. 9, 2796-2805(Sep 1987).

Investigation of the effect of pressure anisotropy on tokamak equilibrium and stability is made with a magnetohydrodynamic model. Realistic perpendicular and parallel pressure distributions, P/sub perpendicular/(psi,B) and P/sub parallel/(psi,B), are obtained by solving a one-dimensional Fokker—Planck equation for neutral beam injection to find a distribution function f (E,v/sub parallel//v) at the position of minimum field on each magnetic surface and then using invariance of the magnetic moment to determine its value at each point on the surface. The shift of the surfaces of constant perpendicular and parallel pressure from the flux surfaces depends strongly on the angle of injection. This shift explains the observed increase or decrease in the stability conditions. Estimates of the stabilizing effect of hot trapped ions indicate that a large fraction must be nonresonant and thus decoupled from the bad curvature before it becomes important.

42758 **Electrostatic end plugging accompanied by a central-cell density increase in an axisymmetric tandem mirror.** Ferron, J.R.; Goulding, R.; Nelson, B.A.; Intrator, T.; Wang, E.Y.; Severn, G.; Hershkowitz, N.; Brouchous, D.; Pew, J.; Breun, R.A.; and others. (University of Wisconsin, Madison, Wisconsin 53706). *Physics of Fluids;* **30**: No. 9, 2855-2869(Sep 1987).

Electrostatic end plugging is observed in a completely axisymmetric, three cell tandem mirror under conditions where the central-cell plasma density is always larger than the end-cell density. A factor of 4 increase in the central-cell density, to a maximum of 1.2 x 10^{13} cm^{-3} with simultaneous plasma beta of 13%, occurs upon application of the end plugging potential. Ion confining potentials of 25 V and 80 V at the two ends of the device, respectively, result in a factor of 2.5 increase in the axial confinement time for T/sub i//sub c/ = 40 eV in agreement with the collisional flow model for ion confinement. The non-Boltzmann ion confining potential is caused by electron heating in the end cells by rf near the ion-cyclotron frequency. The initial central-cell density rise is caused by an increase in the ionization rate that occurs because of an increase in the electron temperature. The density remains high throughout the end-cell heating pulse as a result of increased particle confinement time. There is no nonambipolar radial ion loss in the core plasma (r$\leqq$16 cm) but inward radial transport of ions is observed at a rate consistent with ion—neutral collisions and a radial electric field in the negative radial direction. Steady-state thermal-barrier-like potential dips that are in agreement with the Boltzmann model for potentials are observed in the transitions between the central cell and the end cells.

42759 **Trapping of gun-injected plasma by a tokamak.** Leonard, A.W.; Dexter, R.N.; Sprott, J.C. (Department of Physics, University of Wisconsin, Madison, Wisconsin 53706). *Physics of Fluids;* **30**: No. 9, 2877-2884(Sep 1987).

It has been seen that a plasma produced by a Marshall gun can be injected into and trapped by a tokamak plasma. This trapping of a gun-injected plasma is explained in terms of a depolarization current mechanism. A model is developed that describes the slowing of a plasma beam crossing into the magnetic field of a tokamak. The slowing down time is shown to go as tau/sub s/proportionalT/sup 3/2//sub e/L^2/n/sub b/α^2_0, where n/sub b/ and T/sub e/ are the density and temperature of the plasma beam and α_0/L is the pitch of the field lines per unit length in the direction in which the beam is traveling. Experimental tests of this model are consistent with the scaling predictions.

42760 **Experimental studies of the equilibrium of a linear high-beta l = 1 stellarator.** Hedin, E.R.; Koepke, M.E.; Ribe, F.L. (University of Washington, Seattle, Washington 98195). *Physics of Fluids;* **30**: No. 9, 2885-2892(Sep 1987).

A high-beta linear l = 1 stellarator plasma is produced in a low-compression 3 m theta pinch whose compression coil (22 cm i.d.) is modified to have a helical offset of 2 cm and an axial helical period of 40 cm. Internal probes are used to determine the spatial structure and temporal behavior of the magnetic fields, plasma pressure, and current. The results are well described by ideal magnetohydrodynamic equilibrium theory.

42761 **Finite pressure ballooning mode stability in toroidal equilibriums.** Llobet, X.; Berk, H.L.; Rosenbluth, M.N. (Institute for Fusion Studies, The University of Texas at Austin, Austin, Texas 78712). *Physics of Fluids;* **30**: No. 9, 2750-2758(Sep 1987).

In this paper the effect of finite pressure on the ballooning instability in toroidal magnetohydrodynamics (MHD) equilibria of steep boundary stellarators and tokamaks is examined. Ballooning modes tend to arise near the place where the local shear vanishes and the normal curvature (the curvature component perpendicular to the flux surface, pointing away from the magnetic axis) is negative. It is shown how the pressure gradient determines the position of the shearless points, and demonstrated in detail how this effect explains the existence of second stability in tokamaks. For large aspect ratio circular cross-section tokamaks the second stability condition is found to scale as α = const S/sup 1.25/. Stellarators are inherently more stable because of the negative vacuum shear, which at moderate pressure gradients allows the zero shear point to localize on the inner side of the flux surface. However, at high pressure gradients the Pfirsch—Schlueter current produces a positive mean shear when the total toroidal current on a flux surface is zero. This causes the zero shear point to localize on the outer edge near the vertical extremes of the flux surface. This effect, together with helical contributions to the helical curvature, allows for bal-

looning instability to arise. At higher pressure gradients, with zero net toroidal current, an unstable ballooning mode which localizes to within a helical period always arises where the normal curvature is unfavorable.

42762 **Linear stability of force-free equilibria.** Jensen, T.H.; Chu, M.; Greene, J.M. (GA Technologies, Inc., San Diego, California 92138). *Physics of Fluids;* **30**: No. 9, 2759-2764(Sep 1987).

A sufficient stability criterion, applicable to all force-free equilibria of magnetized plasmas surrounded by a rigid conducting shell, is found. Magnetic field lines may penetrate the shell, vacuum regions may exist inside the shell, and no assumptions on topology: or symmetry: are required. Stability is determined from the sign of the minimum of a functional. This minimum value depends on certain constraints that are adjustable. In one extreme of the range of adjustment, the known stability criterion of ideal magnetohydrodynamics (MHD) is recovered; in the other extreme the criterion approaches that of Taylor equilibria. In this range the constraints relevant for tearing modes are identified. A procedure for evaluating the minimum of the functional, believed suitable for numerical implementation, is given.

42763 **Local effect of equilibrium current on tearing mode stability in the collisional regime. I.** Cozzani, F.; Mahajan, S. (Institute for Fusion Studies, The University of Texas at Austin, Austin, Texas 78712). *Physics of Fluids;* **30**: No. 9, 2765-2773(Sep 1987).

The local effect of the equilibrium current on the linear stability of low poloidal number tearing modes in the collisional regime is investigated analytically. The set of eigenmode equations describing the relevant mode dynamics inside the tearing layer, including the local effect of the equilibrium current, is solved variationally to derive the dispersion relations for the m≧2 and m = 1 tearing modes. The local effect of the equilibrium current is found to increase the well-known FKR growth rate for the classical tearing mode, to enhance stabilization for the m≧2 drift-tearing mode, and to slightly increase the growth rate for the m = 1 mode.

42764 **Linear stability analysis of compact toroidal plasmas using particle simulation.** Mikic-acute-accent, Z.; Morse, E.C. (Department of Nuclear Engineering, University of California, Berkeley, California 94720). *Physics of Fluids;* **30**: No. 9, 2806-2824(Sep 1987).

A technique is presented for the linear three-dimensional stability analysis of plasmas in which ion kinetic effects are important. This technique is appropriate for the analysis of compact toroidal plasmas such as spheromaks, field-reversed mirrors and theta pinches, field-reversed configurations, and ion rings and layers. The plasma is modeled by the hybrid quasineutral model, in which the ions are represented by particles. An initial value approach is used to find the most rapid instabilities, in conjuction with the numerical integration of the equations. The model is verified against known analytic and numerical results for the linear stability of ion layers and theta pinches. The tilt instability in the spheromak is investigated, and comparison is made to magnetohydrodynamic (MHD) stability results for an equilibrium with a low ion beta.

42765 **Finite beta effects on ion temperature gradient driven modes.** Dong, J.Q.; Guzdar, P.N.; Lee, Y.C. (Laboratory for Plasma and Fusion Energy Studies, University of Maryland, College Park, Maryland 20742). *Physics of Fluids;* **30**: No. 9, 2694-2702(Sep 1987).

A set of coupled integral equations is derived to investigate the finite beta effects on the slab ion temperature gradient driven modes for a collisionless plasma in a sheared magnetic field. Low beta plasma is considered so that only the parallel component of perturbed vector potential A-italic-tilde/sub parallel/ and the perturbed scalar potential phi-tilde are involved. Comprehensive parametric studies show that finite beta of several percent could have significant stabilization effects on the slab modes under investigation.

42766 **Nonlinear absorption of intense microwave pulses.** Nevins, W.M.; Rognlien, T.D.; Cohen, B.I. (Lawrence Livermore National Laboratory, Livermore, California 94550). *Physical Review Letters;* **59**: No. 1, 60-63(6 Jul 1987). Contract W-7405-ENG-48.

Free-electron lasers in the electron cyclotron frequency range have been proposed as an efficient means of heating and driving current in tokamak plasmas. The proposed free-electron laser will have short pulses (≃5 x 10/sup -8/ sec) with a peak power of (4—8) x 10^9 W and electric fields within the plasma in the range 10^5—10^6 V/cm. At these high intensities nonlinear effects compete with thermal effects in the absorption of microwave power. Analytic and numerical calculations of the nonlinear absorption are presented.

42767 **Langmuir probe measurements in the TEXTOR tokamak during ALT-I pump limiter experiments.** Goebel, D.M.; Campbell, G.A.; Conn, R.W.; Leung, W.K.; Dippel, K.H.; Finken, K.H.; Thomas, G.J.; Ponteau, A.E. (California Univ., Los Angeles, USA; Kernforschungsanlage Juelich G.m.b.H., Germany, F.R. Inst. fuer Plasmaphysik; Sandia National Labs., Albuquerque, NM, USA). *Plasma Physics and Controlled Fusion;* **29**: No. 4, 473-495(Apr 1987).

Langmuir proves have been used to characterize the edge plasma of the TEXTOR Tokamak and measure the parameters of the plasma incident on the ALT-I pump limiter during ohmic and ICRH heating. Probes mounted directly on the ALT limiter, and a scanning probe located 90° toroidally from the limiter, provide data for the evaluation of pump limiter performance and its effect on the edge plasma. The edge plasma is characterized by density and flux e-folding lengths of about 1.8 cm when ALT is the main limiter. These scrape-off lengths do not vary significantly as ALT is moved between the normal 42-46 cm minor radii, but increase to over 2.2 cm when ALT is inserted to 40 cm The flux to probes at a fixed position in the limiter shadow varies by less than 25% for core density changes of a factor of five. This suggests that the global particle confinement time, tau/sub p/, scales as the core density. Estimates from the probes indicate that tau/sub p/ is on the order of the energy confinement time, tau/sub E/. The edge electron temperature, T/sub e/, typically decreases by a factor of two when the core density is raised from 1 to 4 x 10^{13} cm^{-3}. The T/sub e/ profile is essentially flat in the limiter shadow, with values of 10-25 eV depending on the core plasma density and ICRH power. ICRH heating increases the edge electron temperature and flux in proportion to the coupled power. With ALT as the primary limiter and no direct shadowing, the ion side receives 2-3 times the flux of the electron side during both ohmic and ICRH heating. The edge plasma is not directly modified by pump limiter operation, but changes with the core plasma density as particle removal lowers the recycling of neutrals in the boundary.

42768 **Plasma containment device.** Shelton, J.D. US Patent 4,654,561. 31 Mar 1987. Filed date 7 Oct 1985. vp.

This patent describes a plasma containment device for generating and sustaining a ball of plasma comprising enclosure means for providing a sealed environment for plasma formation; primary electromagnet means having oppositely positioned pole pieces positioned in coaxial alignment with a magnetic field central axis for generating a primary magnetic field in the enclosure means; gas jet means positioned at terminal end portions of pole pieces in generally parallel alignment therewith for providing gas under pressure to the enclosure means for subsequent ionization for plasma ball formation during an initial pressurization model of operation and for preventing touching contact between the electromagnet opposite pole pieces and a plasma ball generated in the enclosure in a plasma ball sustaining model of operation; gas discharge means for selectively sealing the enclosure during the initial pressurization mode of operation and for discharging gas from the enclosure during the plasma ball sustaining mode of operation; gas ionization means for ionizing gas at a central position within the magnetic field during the initial pressurization mode of operation; plasma energizing means for selectively providing energy to the plasma ball during the plasma ball sustaining mode of operation for maintaining an energy level in the plasma ball of a selected magnitude.

42769 **Simulation of the diagnostic neutral beam for active charge-exchange measurements on the Tokamak Fusion Test Reactor.** Medley, S.S. (Plasma Physics Lab., Princeton Univ., P.O. Box 451, Princeton, NJ 08544). *Fusion Technology;* **11**: No. 2, 346-364(Mar 1987).

A diagnostic neutral beam (DNB) is used in the Tokamak Fusion Test Reactor (TFTR) to provide a time-modulated, spatially localized enhancement of the signal in the charge-exchange (CX) diagnostic. Two autonomous charge-exchange neutral analyzer (CENA) systems have been designed for the TFTR. The first system measures the plasma ion temperature along as many as 12 vertical line-of-sight chords spaced approximately equidistantly across the torus minor diameter. The second system emphasizes the measurement of ion phenomena associated with neutral beam injection heating and has a fanlike field of view along six sightlines in the equatorial plane.

42770 **Pulsed plasma jet igniters: Species measurements in nitrogen and air.** Cavolowsky, J.A.; Breber, P.R.; Oppenheim, A.K.; Lucas, D. Northridge, CA; Combustion Institute (1986). 27p. (CONF-8610160—). Combustion Institute, Western States Sect., c/o L.S. Caretto, Calif. State Univ., Northridge, CA 91330. Contract AC03-76SF00098.

From IAEA technical committee meeting on gas-cooled reactors and their applications; Juelich, F.R. Germany (20 Oct 1986). Technical Paper OMWSS/CI LBL-21899.

A molecular beam mass spectrometer was used to obtain quantitative data on the species present in the core regions of nitrogen and air plasma jets. The dilution of the jet as ambient gas is entrained into the turbulent plume was measured by probing an argon jet discharging into a nitrogen atmosphere. The gas from the jet igniter cavity is diluted by more than a factor of ten in the first 4 mm downstream of the orifice, with a further dilution of 40% over the next 8 mm of jet penetration. Comparison of peak mole fractions of reactive species in the jet with the dilution results indicate that the plasma species are not decaying at a rate solely due to dilution. The nitrogen plasma jet was probed for metastable nitrogen (N/sub 2/*) and N atoms as a function of time at various distances along the centerline of the jet. Peak mole fractions of metastable nitrogen and N atoms plotted as a function of probe location demonstrate that N/sub 2/* persists at distances farther downstream than N atoms. Metastable nitrogen concentrations are relatively constant from 4 to 14 mm, indicating that metastable nitrogen is produced in the plume. Nitrogen atoms, oxygen atoms, and nitric oxide were measured in an air plasma. Nitric oxide persists significantly longer than the atoms, and has a peak mole fraction at the point where O and N decrease significantly. The O atom mole fraction of 0.02 is an order of magnitude higher than the N atom concentration, but the radical concentration in the air plasma is lower than that in pure N/sub 2/. No evidence of metastable nitrogen was found in this system. The chemistry with respect to these results is discussed, both in terms of the kinetics of the system and calculated equilibrium concentrations.

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REFER ALSO TO CITATION(S) 40949, 41285, 41289, 41392, 41620, 41625, 41669, 41703, 42679, 42748, 42769

42771 **(CONF-870405—15) Skyshine study for next generation of fusion devices.** Gohar, Y.; Yang, S. (Argonne National Lab., IL (USA)). Feb 1987. Contract W-31109-ENG-38. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011531.

From Topical conference on theory and practice in radiation protection and shielding; Knoxville, TN, USA (22 Apr 1987).

A shielding analysis for next generation of fusion devices (ETR/INTOR) was performed to study the dose equivalent outside the reactor building during operation including the contribution from neutrons and photons scattered back by collisions with air nuclei (skyshine component). Two different three-dimensional geometrical models for a tokamak fusion reactor based on INTOR design parameters were developed for this study. In the first geometrical model, the reactor geometry and the spatial distribution of the deuterium-tritium neutron source were simplified for a parametric survey. The second geometrical model employed an explicit representation of the toroidal geometry of the reactor chamber and the spatial distribution of the neutron source. The MCNP general Monte Carlo code for neutron and photon transport was used to perform all the calculations. The energy distribution of the neutron source was used explicitly in the calculations with ENDF/B-V data. The dose equivalent results were analyzed as a function of the concrete roof thickness of the reactor building and the location outside the reactor building.

42772 **(CONF-870410—30) Processing and waste disposal representative for fusion breeder blanket systems.** Finn, P.A.; Vogler, S. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011414.

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

This study is an evaluation of the waste handling concepts applicable to fusion breeder systems. Its goal is to determine if breeder blanket waste can be disposed of in shallow land burial, the least restrictive method under US Nuclear Regulatory regulations. The radionuclides expected in the materials used in fusion reactor blankets are described, as are plans for reprocessing and disposal of the components of different breeder blankets. An estimate of the operating costs involved in waste disposal is made.

42773 **(CONF-870812—8) A review of the structural aspects of the Large Coil Task.** Lubell, M.S.; Clinard, J.A.; Lue, J.W.; Luton, J.N.; McManamy, T.J.; Shen, S.S. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87007371.

From 9. SMIRT: international conference on structural mechanics in reactor technology; Lausanne, Switzerland (17 Aug 1987).

The Large Coil Task (LCT) was initiated a decade ago by the United States (US), EURATOM (EU), Japan (JA), and Switzerland (CH) under the auspices of the International Energy Agency (IEA) to develop superconducting magnets for toroidal field coils for tokamak fusion reactors. Under the IEA agreement, EU, JA, and CH each fabricated one coil and shipped it to the Oak Ridge National Laboratory (ORNL), where the coils were assembled, along with three US coils (GD, GE, and WH), in the International Fusion Superconducting Magnet Test Facility (IFSMTF) which was designed and built at ORNL. In addition to the fact that six widely varying designs are being tested under similar conditions in the same test facility, the LCT project is unique in at least two other aspects. First, these are the largest superconducting (SC) coils fabricated and tested to date for research and development of SC magnets. Second, as the magnets themselves are the experiment, they are each heavily instrumented; consequently, detailed information on thermal, electrical, and mechanical performance has been obtained, some for the first time on SC magnets of any size. This paper concentrates on those aspects of the tests most relevant for fusion reactor magnets: the structural measurements and simulated nuclear heating tests. Data on the US PB coils (GD and GE) and the US FF coil (WH) are used to illustrate the results. All six coils have achieved 100% design current at 8-T field and that in a symmetric torus arrangement all six coils have been simultaneously energized to 8 T.

42774 **(CONF-870812—17) Some stress-related issues in tokamak fusion reactor first walls.** Majumdar, S.; Pai, B.; Ryder, R.H. (Argonne National Lab., IL (USA); Purdue Univ., Hammond, IN (USA); GA Technologies, Inc., San Diego, CA (USA)). Jan 1987. Contract W-31109-ENG-38. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011461.

From 9. SMIRT: international conference on structural mechanics in reactor technology; Lausanne, Switzerland (17 Aug 1987).

Recent design studies of a tokamak fusion power reactor and of various blankets have envisioned surface heat fluxes on the first wall ranging from 0.1 to 1.0 MW/m^2, and end-of-life irradiation fluences ranging from 100 dpa for the austenitic stainless steels to as high as 250 dpa for postulated vanadium alloys. Some tokamak blankets, particularly those using helium or liquid metal as coolant/

breeder, may have to operate at relatively high coolant pressures so that the first wall may be subjected to high primary stress in addition to high secondary stresses such as thermal stresses or stresses due to constrained swelling. The present paper focusses on the various problems that may arise in the first wall because of stress and high neutron fluence, and discusses some of the design solutions that have been proposed to overcome these problems.

42775 **(CONF-8703140—2-Vugraphs) Presentation at FTP: A review.** Sheffield, J. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87008791.

From Field task proposal agreement review meeting; Washington, DC, USA (24 Mar 1987).

This series of vugraphs presents some information concerning ORNL's involvement in the fusion energy research program. Recent and future experiments are named, and a rough estimate of funding is given. (JDH)

42776 **(EFI—848(75)-85) Optimization of high-current solenoid coil form for obtaining strong pulsed magnetic fields.** Karagezov, Eh.I. (Erevanskij Fizicheskij Inst. (USSR)). 1985. 26p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. File Number DE87702698.

The form of one-piece-turned spiral and band solenoids in which clarified acoustics is used to absorb the sound wave, is optimized, to strengthen the construction and minimize the number of contacts the final whorls of spiral solenoids go over to massive ripped washers. For the first time the form factor equations for the represented geometries are derived which are important while selecting the solenoids.

42777 **(EUR-CEA-FC—1306) Accurate frequency measurements on gyrotrons using a "gyro-radiometer".** Rebuffi, L. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France). Dept. de Recherches sur la Fusion Controlee). Aug 1986. 65p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87751839.

Using an heterodyne system, called "Gyro-radiometer", accurated frequency measurements have been carried out on VARIAN 60 GHz gyrotrons. Changing the principal tuning parameters of a gyrotron, we have detected frequency variations up to 100 MHz, -- 40 MHz frequency jumps and smaller jumps (-- 10 MHz) when mismatches in the transmission line were present. FWHM bandwidth of 300 KHz, parasitic frequencies and frequency drift during 100 msec pulses have also been observed. An efficient method to find a stable-, high power-, long pulse-working point of a gyrotron loaded by a transmission line, has been derived. In general, for any power value it is possible to find stable working conditions tuning the principal parameters of the tube in correspondence of a maximum of the emitted frequency.

42778 **(GA-A—18854) Cost comparison of ECH [Electron Cyclotron Heating] relative to other RF heating systems.** Remsen, D.B. Jr. (GA Technologies, Inc., San Diego, CA (USA)). 1987. Contract AC03-84ER51044. 13p. (CONF-870607—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011328.

From International symposium on gyrotrone and free electron laser; Chengdu, China (1 Jun 1987).

Electron Cyclotron Heating of toroidal plasmas has many performance advantages over other plasma heating methods. However, up to the present time, ECH systems have been economically uncompetitive with other RF heating techniques, primarily due to the unavailability of tubes with high unit power in the ECH frequency range. High power RF systems consisting of a large number of small modules become complex and expensive due to the multiplicity of support, ancillary, interlock and control equipment necessary. This need no longer be true with the projected availability of "megawatt" ECH power tubes. This paper will demonstrate the economic benefits to be obtained from the development of such tubes relative to present ECH and other RF plasma heating systems.

42779 **(IAE—4218(7)) Possibility of thermonuclear reaction ignition in constriction of Z-pinch.** Yan'kov, V.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1985. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702726.

Possibility of thermonuclear reaction ignition in constriction of Z-pinch with the burning spread to the whole pinch is considered at the estimate level. Degenerated gas pressure limits the current, which should exceed 5 MA. Characteristic constriction size necessary for ignition is 10^{-4} cm. 12 references.

42780 **(INDC(CCP)—266/G) Total absorption method in measurements of 14 MeV neutron multiplication factors.** Zagryadskij, V.A.; Markovskij, D.V.; Nourkov, V.M.; Chuvilin, D.Yu.; Shatalov, G.E. (International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee). Mar 1987. 18p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702754.

The paper deals with methodological questions arising in connection with the measurement of neutron leakage from spherical assemblies simulating multiplication zones of controlled thermonuclear reactor blankets. A boron tank, which has a number of advantages over other detectors of total absorption, served as the neutron detector. On the basis of the calculations performed, it was shown that surrounding the assembly under study with a layer of borated water serving as a neutron detector does not affect the processes of 14 MeV neutron multiplication. The boron tank has a constant recording efficiency for neutrons in the 0-6 MeV energy range. A procedure is proposed for measuring the leakage of neutrons from spherical samples with a central 14 MeV source. Translated from Russian. 8 references, 3 figures, 3 tables.

42781 (INIS-mf—10917, pp 122) **High power cw-discharge multi kHz repetition rate q-switch carbon dioxide lasers.** Ambrosio, C. d; Fuss, W.; Schmid, W.E.; Kompa, K.L. (Max-Planck-Institut fuer Quantenoptik, Garching, Germany, F.R.). 1986. NTIS (US Sales Only), PC A07/MF A01. File Number DE87780153. (CONF-860919—Absts.).

From 6. international symposium on gas flow and chemical lasers; Jerusalem, Israel (8 Sep 1986).

42782 (INIS-mf—10917, pp 43) **Particle acceleration in laser plasma interaction.** Bobin, J.L. 1986. NTIS (US Sales Only), PC A07/MF A01. File Number DE87780153. (CONF-860919—Absts.).

From 6. international symposium on gas flow and chemical lasers; Jerusalem, Israel (8 Sep 1986).

42783 **(ITEF—109(1986)) Thomson spectrograph with the visualization of ion paraboles by means of microchannel plates.** Kondrashev, S.A.; Krechet, K.I.; Khajdarov, R.T.; Sharkov, B.Yu. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1986. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702807.

Design and main characteristics of Thomson spectrograph aimed at investigating heavy ion beam charge formed by laser plasma is described. Spectrograph monitoring is modified particularly for analysis in one laser shot of pulse ion flux on the screen of ion-optical converter on the base of microchanel plate. Ion energies, ion beam charge composition and distribution of ion number in charges for ^{207}Pb ion beam extracted from high-temperature laser plasma are determined. 6 references, 5 figures.

42784 **(JAERI-M—86-081) Atomic structure calculations of Mo XV-XL.** Kubo, H.; Sugie, T.; Shiho, M.; Suzuki, Y.; Ishii, K.; Maeda, H. (Japan Atomic Energy Research Inst., Tokyo). Jun 1986. 228p. (In Japanese). NTIS (US Sales Only), PC A11/MF A01. File Number DE87702610.

Energy levels and oscillator strengths were calculated for Mo XV - Mo XL. The computer program for atomic structure calculation, developed by Dr. Robert D. Cowan, Los Alamos National Laboratory, was used in the present work. The scaled energy pa-

rameters were empirically determined from the observed spectral data. The authors present wavelengths and transition probabilities of Mo XV-XL. Energy levels and spectral patterns are presented in figures that are useful for the identification of spectral lines.

42785 **(JAERI-M—86-096) Finite element circuit theory of the numerical code EDDYMULT for solving eddy current problems in a multi-torus system.** Nakamura, Y.; Ozeki, T. (Japan Atomic Energy Research Inst., Tokyo). Jul 1986. 63p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87702611.

The finite element circuit theory is extended to the general eddy current problem in a multi-torus system, which consists of various torus conductors and axisymmetric coil systems. The numerical procedures are devised to avoid practical restrictions of computer storage and computing time, that is, the reduction technique of eddy current eigen modes to save storage and the introduction of shape function into the double area integral of mode coupling to save time. The numerical code EDDYMULT based on the theory is developed to use in designing tokamak device from the viewpoints of the evaluation of electromagnetic loading on the device components and the control analysis of tokamak equilibrium.

42786 **(JAERI-M—86-103) Coupling to fast waves via a phased loop antenna array for fast wave current drive in the JFT-2M tokamak.** Uesugi, Y.; Yamamoto, T.; Ohtsuka, H.; Kikuchi, K. (Japan Atomic Energy Research Inst., Tokyo). Jul 1986. 12p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702612.

A phased loop antenna array was employed to launch fast waves into a plasma in which the frequency is of the order of 10 ω/sub ci/. A high loading resistance of about 5 Ω was obtained and its value agrees well with the theoretical estimation. The loading efficiency of about 80% was obtained at a frequency of 200 MHz. The travelling fast waves were excited by phase control of the two loop antennas array and the excitation of the waves like coaxial mode was observed at in-phase feeding of two loop antennas. Use of the fast wave for steady state current drive was suggested.

42787 **(JAERI-M—86-113) Power test of the JT-60 ICRF launching system.** Kimura, H.; Fujii, T.; Ikeda, Y.; Saigusa, M.; Sagawa, J.; Seki, M.; Uehara, M.; Kobayashi, N.; Saito, Y. (Japan Atomic Energy Research Inst., Tokyo). Aug 1986. 31p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87702613.

Impedance matching and power test of the JT-60 ICRF launching system was performed on the test stand before installation into the JT-60 vacuum vessel. Impedance matching of the 2 x 2 phased loop antenna array was confirmed with various phasing conditions. The antenna input impedance changes considerably according to the phasing because of the mutual coupling among the loops. Multipactoring discharge was observed and its power region was clarified. Rf energy of 1 MJ could be injected into the half part of the launching system after the aging of effectively 2 days. Observation of the aging process, such as gas desorption, mass analysis, measurement of the temperature of the launcher etc., is discussed.

42788 **(JAERI-M—86-129) In-situ tritium release experiment from tritium breeder materials. Measurement apparatus and safety assessment of VOM-21H and 22H.** Kurasawa, T.; Takeshita, H.; Aizawa, M.; Ohno, H.; Mimura, K.; Watanabe, H.; Yoshida, H.; Umei, H. (Japan Atomic Energy Research Inst., Tokyo). Sep 1986. 30p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. File Number DE87702616.

Tritium recovery characteristic is a critical issue associated with the performance of tritium breeder and development of fusion reactor. As known widely, the released tritium is very sensitive to the amount of impurity moisture and oxygen in the measurement system. Then the key point for good measurement exists to establish an improved measurement apparatus. These new tritium measurement apparatA (No.2 and No.3) were constructed with effective use of operating experiences of No.1 apparatus for VOM-15H Experiment. This report includes a detailed description of improved apparatus and data of neutronics and thermohydraulics calculation for tritium safety assessment of apparatus and capsule. The irradiation of VOM-21H and 22H had been conducted during 10 cycles and 8 cycles respectively.

42789 **(JAERI-M—86-134) Conceptual design study of fusion experimental reactor (FER). (FY 1984, 85 report).** (Japan Atomic Energy Research Inst., Tokyo). Nov 1986. 933p. (In Japanese). NTIS (US Sales Only), PC A99/MF A01. File Number DE87702618.

Since 1980 the design study has been conducted at JAERI for the Fusion Experimental Reactor (FER) which has been proposed to be the next machine to JT-60 in the Japanese long term program of fusion reactor development. During two years from 1984 to 1985 FER concept was reviewed and redesigned. This report is the summary of the results obtained in the review and redesign activities in 1984 and 1985. In the first year FER concept was discussed again and its frame work was reestablished. According to the new frame work the major reactor components of FER were designed. In the second year the whole plant system design including plant layout plan was conducted as well as the more detailed design analysis of the reactor conponents. The newly established frame for FER design is as follows: 1) plasma: self-ignition; 2) operation scenario: quasi-steady state operation with long burn pulse; 3) neutron fluence on the first wall: 0.3 MWY/M^2; 4) blanket: non-tritium breeding blanket with test modules for breeding blanket development; and 5) magnets: superconducting magnets.

42790 **(JAERI-M—86-147) Improved confinement during ICRF heating on JFT-2M.** Matsumoto, H.; Ogawa, T.; Tamai, H. (Japan Atomic Energy Research Inst., Tokyo). Oct 1986. 20p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702629.

Significant improvement of energy confinement was observed on JFT-2M during ICRF heating. This improvement is associated with the sudden depression of H/sub α//D/sub α/ emission and the following increase of plasma stored energy, electron density and the radiation loss. This should be the same phenomena as H-mode transitions observed in ASDEX, PDX, and D-III divertor experiments with neutral beam injection heating. However, this transition is also observed in limiter discharges as well as in open divertor configurations on JFT-2M.

42791 **(JAERI-M—86-148) Characteristics of pellet and neutral-beam injected single null divertor discharges of the JFT-2M tokamak.** Miura, Y.; Kasai, S.; Sengoku, S. (Japan Atomic Energy Research Inst., Tokyo). Sep 1986. 21p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87702630.

When a single pellet is injected before the H-mode (high confinement mode) transition of neutral-beam heated single null divertor discharges, three different types of discharges are classified by the increment of line-averaged electron density (Δn-bar/sub ep/) at the pellet injection time. One of these three types of the discharges is obtained only in the transient phase, however, the very high confinement state of the neutral-beam heated plasma is discovered. The characteristics of this type of the discharge are as follows; when Δn-bar/sub ep/ is greater than about 4 x 10^{19} m^{-3}, the energy confinement time exceeds that of ohmically heated discharges and volume averaged toroidal beta, $<\beta$/sub t/$>$, reaches close to the β-limit by only the neutral-beam power of 0.69 MW ($<\beta$/sub t/$>$ — 1.6 % at I/sub P/ = 0.22 MA, a = 0.25 m, B/sub T/ = 1.2 T and q/sub psi/ — 2.5).

42792 **(JAERI-M—86-152) In-pile test of tritium release from tritium breeding materials (VOM-21H experiment). Tritium release and behavior from lithium oxide.** Kurasawa, T.; Takeshita, H.; Watanabe, H.; Yoshida, H. (Japan Atomic Energy Research Inst., Tokyo). Oct 1986. 85p. (In Japanese). NTIS (US Sales Only), PC A05/MF A01. File Number DE87702632.

Material development and blanket design of lithium-based ceramics such as lithium oxide, lithium aluminate, lithium silicate and lithium zirconate have been performed in Japan, United State of America and Europian Communities. Lithium oxide is a most attractive candidate for tritium breeding materials because of its high lithium density, high thermal conductivity and good tritium release

performance. This work has been done to clarify the characteristics of tritium release and recovery from Li_2O by means of in-situ tritium release measurement. The effects of temperature and sweep gas composition on the tritium release were investigated in this VOM-21H Experiment. Good measurement of tritium release was achieved but there were uncertainties in reproduciblity of data. The experimental results show that the role of surface adsorption/desorption makes a significant contribution to the tritium release and tritium inventory. Also, it is necessary to define the rate limiting process either diffusion or surface adsorption/desorption.

42793 **(JAERI-M—86-170) Ablation of hydrogen ice pellet in JT-60 plasma.** Hirayama, T.; Yamada, K.; Sengoku, S.; Nagami, M. (Japan Atomic Energy Research Inst., Tokyo). Oct 1986. 36p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87702640.

Ablation of hydrogen ice pellet in the JT-60 plasma was calculated by ORNL pellet ablation code, which employs a neutral gas shielding model. An optimum scheme to produce central peaked n/sub e/ profile of n/sub e/(O) = 2 X 10/sup —3/ and n/sub e/(O)/<n/sub e/> — 3 in the ohmic discharge appears to be a pellet injection with the pellet size of 3.4 mm diameter and velocity of 2 km/s. Under the assumption of electron heat diffusivity X/sub e/ = 2 x 10^{19}/n/sub e/ (m^2/s), the 1-D tokamak code (LIBRARY) predicts — 30% increment of fusion multiplication (Q) for pellet fueled peaked density profile compared with gas fueled discharge.

42794 **(JAERI-M—86-173) Plasma wall interactions in ohmically heated discharge of JT-60 tokamak.** Nakamura, H.; Ando, T.; Niikura, S.; Arai, T.; Yamamoto, M. (Japan Atomic Energy Research Inst., Tokyo). Nov 1986. 40p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87702643.

In this paper, the experimental results of plasma wall interactions in ohmically heated (OH) divertor and limiter discharges of JT-60 tokamak were described. In JT-60, all of the first wall has been coated by TiC of 20 μm thick. Therefore, several interesting features were observed on discharge characteristics. High efficiency of Taylor type low current pulse discharge cleaning in JT-60 TiC coated wall was observed. Density control was possible even in a limiter discharge due to pumping ability of TiC wall. Heat load reduction by remote radiative cooling was observed in a divertor plate. Mo impurity was not observed in the JT-60 ohmic heating experiment except a plasma disruption. After the OH experiment, an observation of the first wall was carried out. Among 10000 pieces of the first wall components, severe melting of Mo substrate was observed only in a limiter at inboard side. In the pump limiter experiment, exhaust rate of 0.11 Pa center dot m^3/sec was obtained at n-bar/sub e/ = 2 x 10^{19} m^{-3}. Moreover, in the divertor pumping experiment, pressure in the divertor chamber increased in proportion to n-bar/sub $e/^2$. A high pressure of 0.13 Pa was observed at n-bar/sub e/ = 6 x 10^{19} m^{-3}. Compression ratio was 40.

42795 **(JAERI-M—86-182) Fusion blanket benchmark experiments on a 60 cm-thick lithium-oxide cylindrical assembly.** Maekawa, H.; Ikeda, Y.; Oyama, Y.; Yamaguchi, S.; Tsuda, K.; Nakamura, T.; Fukumoto, T.; Kosako, K.; Yoshizawa, M. (Japan Atomic Energy Research Inst., Tokyo). Dec 1986. 82p. NTIS (US Sales Only), PC A05/MF A01. File Number DE87702648.

Integral experiments on a Li_2O cylindrical assembly have been carried out, using the FNS facility to provide benchmark data for verification of methods and data used in fusion neutronics research. The size of assembly was 63 cm (diameter) by 61 cm (length). Measurements included ^{6}Li and ^{7}Li tritium production rates; ^{235}U, ^{238}U, ^{237}Np and ^{232}Th fission rates; and $^{27}Al(n,\alpha)^{24}Na$, $^{58}Ni(n,2n)^{57}Ni$, $^{115}In(n,n^1)$/sup 115(sup m)/In and $^{115}In(n,\gamma)^{116}In$ reaction rates. Neutron energy spectra in the assembly, as well as response rates of TLDs and PIN diodes, were also measured. Measured data are presented in tabular form together with estimated errors. A sample calculation using the DOT3.5 code is provided to facilitate the reader understanding of the experiments. Although several different measuring techniques are used in the experiment, the data are mutually consistent. This fact supports that present experimental data can be applied to the benchmark verification of methods and data.

42796 **(LBL—22272) Comparison of electric and magnetic quadrupole focusing for the low energy end of an induction-linac-ICF [Inertial-Confinement-Fusion] driver.** Kim, C.H. (Lawrence Berkeley Lab., CA (USA)). Apr 1987. Contract AC03-76SF00098. 7p. (CONF-870302—187). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010261.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

This report compares two physics designs of the low energy end of an induction linac-ICF driver: one using electric quadrupole focusing of many parallel beams followed by transverse combining; the other using magnetic quadrupole focusing of fewer beams without beam combining. Because of larger head-to-tail velocity spread and a consequent rapid current amplification in a magnetic focusing channel, the overall accelerator size of the design using magnetic focusing is comparable to that using electric focusing.

42797 **(NRCN—572) Combining laser beams by dispersive prism.** Lotem, H.; Lavi, S. (Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev). May 1986. 8p. (In Hebrew). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702854.

A method of combining laser beams with different wavelengths, by Brewster angle dispersive prism made of $SrTiO_3$ crystal is presented. Such a prism enables combining of beams with 5 nm difference in the red, it has minimal absorption losses and high damage threshold.

42798 **(ORNL/FEDC—87/4) Face compression yield strength of the copper-Inconel composite specimen.** Horie, T. (Oak Ridge National Lab., TN (USA). Fusion Engineering Design Center). May 1987. 24p. NTIS, PC A02/MF. File Number DE87011974.

A new equation for the face compression yield strength of copper-Inconel composite material has been derived. Elastic-plastic finite element analyses were also made for composite specimens with various aspect ratios to examine the edge effect of the specimen. According to the results of both the new equation and the analyses, the face compression yield strength of the composite should be decreased by about 25% from the value obtained with Becker's equation.

42799 **(RISO-M—2536) Investigation of pellet acceleration by an arc heated gas gun. An interim report of the investigations carried out to 31 August 1985.** Andersen, S.A.; Bundgaard, J.; Jensen, V.O.; Nordskov, A.; Sass, B.; Soerensen, H.; Weisberg, K.V. (Risoe National Lab., Roskilde (Denmark)). Dec 1985. 48p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87752324.

Deep penetration of pellets into the JET plasma may prove to be a useful tool for density and profile control. In JET deep penetration will require pellet velocities and sizes above those obtained so far. An experimental setup designed for a study of acceleration of 3 mm diameter pellets by an arc heated gas gun is described. The aim of the work is to obtain pellet velocities well above 2 km/s. To obtain this aim will require a much more powerful power unit than the one that was available for the present work. Only a few results, obtained mostly during testing of the various parts of the setup, are presented. Although the obtained velocities are low (proportional to 1500 m/s) the results are encouraging because they demonstrate that pellets can stand a high acceleration pressure without disintegrating. With a suitable power supply which can maintain this high acceleration pressure as the pellet moves all the way through the barrel, velocities above 2 km/s would certainly be expected.

42800 **(SAND—87-0019C) Operation of the TEMPO machine.** Rohwein, G.J.; Lawson, R.N.; Lancaster, K.T. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 4p. (CONF-870656—18). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011285.

From 6. Institute of Electrical and Electronic Engineers pulsed power conference; Arlington, VA, USA (29 Jun 1987).

The TEMPO machine is a repetitively pulsed, high-voltage driver for experimental microwave generating devices. Three units have been built. TEMPO has a transformer-charged, water-insulated Blumlein directly coupled to the vacuum diode. The Blumlein has a relatively high impedance (20-Ω) strip-type, pulse-forming transmission line (PFL) designed to minimize size. Stray capacitance and enhanced electric fields along the edges of the PFL are controlled by lining the tank in which the Blumlein is housed with polyvinyl chloride (PVC) plastic sheet. During the initial stage of operation, problems with breakdowns in the plastic occurred that necessitated replacing the liner with either polyethylene or polypropylene. During the same period, problems with the power supplies and high voltage switch performance were addressed. These modifications and their results are discussed in the following sections.

42801 **(SAND—87-0190C) PBFA-II energy storage system performance and operation.** Wilson, J.M. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 16p. (CONF-870656—13). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011720.

From 6. Institute of Electrical and Electronic Engineers pulsed power conference; Arlington, VA, USA (29 Jun 1987).

PBFA-II is a thirty-six module ion beam accelerator constructed by Sandia National Laboratories for inertial confinement fusion feasibility studies. Each module of the machine is designed to deliver 2.8 terawatts to a central experimental chamber. The total power delivered to the ion diode (100 terawatts) is expected to permit ignition scaling studies beginning in the late 1980s. The PBFA-II energy storage system is located in an annular oil tank at the outer periphery of the accelerator. Its main component is a set of thirty-six 6.0 MV, 400 kJ Marx generators. In order to properly drive the machine's downline pulse-forming section and the accelerator load, the Marx generator set must erect with a first-to-last spread of less than 40 nsec. The energy storage section is triggered by a chain of pulse amplifiers, beginning with a low voltage trigger pulse from the main control system and culminating in thirty-six 540 kV, 80 nsec risetime pulses used to trigger the Marx generators. Each generator then erects to provide a 110 kA, 5.3 MV, 1.3 μsec pulse to charge the pulse-forming section. The energy storage system is now operational and meeting performance specifications. The performance characteristics of the system are understood over the present operating range, and routine operation and maintenance procedures have been established.

42802 **(SAND—87-0423C) Status of Plasma Opening Switch development for the Particle Beam Fusion Accelerator II (PBFA II).** Rochau, G.E.; McDaniel, D.H.; Moore, W.B.S.; Mowrer, G.R.; Renk, T.J.; Stinnett, R.W.; Woodall, H.N. (Sandia National Labs., Albuquerque, NM (USA)). Jun 1987. Contract AC04-76DP00789. 5p. (CONF-870656—21). NTIS, PC A02. File Number DE87011853.

From 6. Institute of Electrical and Electronic Engineers pulsed power conference; Arlington, VA, USA (29 Jun 1987).

During the last year, we have conducted Plasma Opening Switch (POS) experiments on Sandia National Laboratories' new PBFA II ion beam accelerator (12 MV, 100 TW, 50 ns). Our POS system uses a newly developed flashboard source to provide the plasma required to conduct large currents (6 MA) over large areas (150 to 2500 cm^2). An initial series of experiments has been completed characterizing the behavior of the POS with short circuit, electron beam diode, and applied-B ion diode loads. The tests have demonstrated the need for a more rugged plasma source wih uniform plasma density and for better power flow symmetry. The summary of the test series is presented and discussed.

42803 **(SAND—87-0613C) PBFA [Particle Beam Fusion Accelerator] II: The pulsed power characterization phase.** Martin, T.H.; Turman, B.N.; Goldstein, S.A.; Wilson, J.M.; Cook, D.L.; McDaniel, D.H.; Burgess, E.L.; Rochau, G.E.; Neau, E.L.; Humphreys, D.R. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 9p. (CONF-870656—14). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011726.

From 6. Institute of Electrical and Electronic Engineers pulsed power conference; Arlington, VA, USA (29 Jun 1987).

The Particle Beam Fusion Accelerator II, PBFA II, is now the largest pulsed power device in operation. This paper summarizes its first year and a half of operation for the Department of Energy (DOE) Inertial Confinement Fusion (ICF) program. Thirty-six separate modules provide 72 output pulses that combine to form a 100 TW output pulse at the accelerator center. PBFA II was successfully test fired for the first time on December 11, 1985. This test completed the construction phase (Phase 1) within the expected schedule and budget. The accelerator checkout phase then started (Phase 2). The first priority during checkout was to bring the Phase 1 subsystems into full operation. The accelerator was first tested to determine overall system performance. Next, subsystems that were not performing adequately were modified. The accelerator is now being used for ion diode studies. 32 refs.

42804 **(SAND—87-1512C) Laser-triggered gas switch improvements on PBFA-II.** Wilson, J.M.; Donovan, G.L. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 17p. (CONF-870656—16). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011719.

From 6. Institute of Electrical and Electronic Engineers pulsed power conference; Arlington, VA, USA (29 Jun 1987).

PBFA-II is a thirty-six module ion accelerator built by Sandia National Laboratories for inertial confinement fusion feasibility studies. In the water-filled, pulse-forming section of the accelerator, each module is fitted with a 5.0 MV, SF_6-filled gas switch located between an intermediate storage capacitor and the first pulse-forming line (Line 1). The intermediate storage capacitor is charged to 4.8-5.0 MV in approximately 950 ns by a Marx generator located in the oil section of the machine. The gas switch is required to close on command and transfer the stored capacitor energy to Line 1, a coaxial transmission line of 100 ns two-way electrical length. The switches are triggered by a single 3.0 J KrF laser located under the accelerator; a complex beam-splitting/distribution system is used to deliver simultaneous 20 to 40 mJ, 35 ns FWHM beamlets to the individual switches. In recent experiments on PBFA-II, gas switches have been modified and tested at different gas pressures and voltages. These modifications substantially reduced the switch runtime, jitter, and expected spread. Also, changes to the triggering KrF laser have been shown to significantly affect gas switch performance. The switch modifications will be incorporated into the machine as a retrofit planned for this summer. The laser optical set-up has also been changed as a result of these findings.

42805 **(SAND—87-1657C) TEM [Transverse Electromagnetic] analysis and computer simulations of DEMON and PBFA-II [Particle Beam Fusion Accelerator-II] open transmission-line systems.** Johnson, W.A.; Neau, E.L.; Schneider, L.X. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 7p. (CONF-870656—24). NTIS, PC A02. File Number DE87011864.

From 6. Institute of Electrical and Electronic Engineers pulsed power conference; Arlington, VA, USA (29 Jun 1987).

Transverse Electromagnetic (TEM) multimode analysis and 3-dimensional, time-dependent computer simulations, as well as experiments, have been carried out to quantify the energy-transport efficiencies of the open transmission-line systems of the particle Beam Fusion Accelerator II (PBFA II) and the DEMON accelerator. The insights gained are guiding design efforts to improve the energy-transport efficiency of PBFA II.

42806 **(UCRL—94641) Recent experiments at the Nova facility at the Lawrence Livermore National Laboratory.** Cable, M.; Drake, P.; Glendinning, S.; Hatchett, S.; Kauffman, R.; Kilkenny, J.; Kornblum, H.; Lane, S.; MacGowan, B.; Matthews, D. (Lawrence Livermore National Lab., CA (USA)). Jun 1986. Contract W-7405-ENG-48. 6p. (CONF-860665—20). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011566.

From 6. international conference on high power particle beams; Kobe, Japan (9 Jun 1986).

The Nova laser facility is designed to address critical issues for evaluating the feasibility of Inertial Confinement Fusion, to implode DT to densities exceeding 200 g/cm^3, and to perform a wide

range of high energy density plasmas physics experiments in the areas of XUV/x-ray lasers, hydrodynamics, and radiation generation and transport. The ten-arm Nova laser is capable of irradiating complex targets with laser wavelengths of 0.53 and 0.35 μm, pulse widths from 0.09 ns to >5 ns, peak powers greater than several terawatts per beam line, and temporally shaped pulses. The output of the laser can be directed into two independent target areas; a 4.6 m diameter vacuum vessel for experiments which require ten beams and a 1.8 m diameter chamber for two Nova arms. A number of sophisticated optical, XUV, x-ray and particle diagnostics measure target performance. An overview of the facility will be presented and recent target experiments will be discussed. These target experiments include studies of forward stimulated Raman scattering and hot electron production, ablation pressure, XUV lasers, x-ray conversion efficiencies and implosions.

42807 **(UCRL—96774) Millimeter wave tokamak heating and current drive with a high power free electron laser.** Thomassen, K.I. (Lawrence Livermore National Lab., CA (USA)). 1987. Contract W-7405-ENG-48. 19p. (CONF-870765—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011324.

From 14. annual conference on plasma physics; St. Andrew, UK (1 Jul 1987).

Experiments on microwave generation using a free electron laser (FEL) have shown this to be an efficient way to generate millimeter wave power in short, intense pulses. Short pulse FEL's have several advantages that make them attractive for application to ECR heating of tokamak fusion reactors. This paper reports on plans made to demonstrate the technology at the Microwave Tokamak Experiment (MTX) Facility.

42808 **(UCRL—96830) The need for a fusion technology information program.** Correll, D.L. Jr. (Lawrence Livermore National Lab., CA (USA)). 16 Jun 1987. Contract W-7405-ENG-48. 11p. (CONF-8706111—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE87011886.

From 12. annual meeting and international symposium of the Technology Transfer Society; Washington, DC, USA (22 Jun 1987).

In providing an adequate energy technology for the future, which new programs should be considered by the Department of Energy national laboratories to ensure that the US remains in the forefront of international science and technology is an important question. This paper suggests that the urgency for energy independence demands an active communication program that would increase awareness of energy as a critical national issue and would present fusion, with its benefits and risks, as one of the long-term alternative energy sources.

42809 **Analysis of forces on inertial confinement fusion targets during ablation layer coating.** Gracewski, S.M.; Gram, R.Q. (Mechanical Engineering Department, University of Rochester, Rochester, New York 14627). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **5**: No. 5, 2941-2944(Sep 1987).

Ablation layer coating of inertial confinement fusion targets is accomplished while the targets are bounced on the surface of a mechanical resonator. Under certain conditions the targets stick to the resonator at low amplitudes and bounce too high and escape or break at high amplitudes. An analytical model of a bouncing target is considered to determine important parameters in the bouncing process. The resonant frequency of the target is found to be two orders of magnitude higher than the mechanical resonator frequency and therefore not an important factor in unsticking targets. Experiments have been carried out to determine the adhesive force between the mechanical resonator and the targets and the effect of a plasma on this adhesive force.

42810 **Radioluminescence of individual deuterium—tritium-filled glass microbubble laser targets.** Smith, G.H.; Souers, P.C.; Fearon, E.M.; Tsugawa, R.T.; Darling, D.H. (Lawrence Livermore National Laboratory, Livermore, California 94550). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **5**: No. 5, 2954-2956(Sep 1987). Contract W-7405-ENG-48.

Visible radioluminescence was observed from single 200-μm-diam deuterium—tritium (D—T)-filled glass microbubble laser targets. Most of the light is caused by tritium beta particles hitting the glass, and no beta particles escape outside the microbubble. At room temperature, white light is created with an efficiency of 0.2 to 0.3 photons/beta particle. This efficiency rises an order of magnitude at 35 K, probably because of freezing of radiation defects into the glass. It decreases when the D—T liquifies and drops even lower upon solidification. This is probably caused by pooling of the D—T at the bottom of the microbubble plus light absorption in small crystallites. Radioluminescence offers a means of certifying the D—T fill of individual microbubble laser targets made of transparent material.

42811 **Coupling analysis for the ICRF resonant cavity launcher on DIII-D.** Mau, T.K.; Chiu, S.C.; Baker, D.R. (School of Engineering and Applied Science, Univ. of California, Los Angeles, CA). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science;* **PS-15**: No. 3, 273-284(Jun 1987).

The coupling properties of the ion-cyclotron range of frequencies (ICRF) resonant cavity launcher for DIII-D were investigated with a two-dimensional (2-D) model. In the context of the magnetostatic approximation, Poisson's equation was solved for the vector potential with a self-consistent antenna current distribution. The tool of analysis is a fast 2-D Poisson solver which takes into account the plasma medium and the shape of the cavity wall and antenna cross section. This permits the design of the optimum configuration for such a launcher to be used on the DIII-D tokamak. Extensive parametric studies of the launcher loading impedance were carried out.

42812 **An algorithm for the analysis of inductive antennas of arbitrary cross section for heating in the ion cyclotron range of frequencies.** Lehrman, I.S.; Colestock, P.L. (Grumman Aerospace Corp., Princeton, NJ 08540). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science;* **PS-15**: No. 3, 285-293(Jun 1987).

The application of ion cyclotron range of frequency (ICRF) heating to near-ignited plasmas will require launching structures that will be capable of withstanding the harsh plasma environment. The recessed antenna configuration is expected to provide sufficient protection for the structure, but do date no analysis has been done to determine if adequate coupling can be achieved in such a configuration. In this work the authors present a method for determining the current distribution for the antenna in the direction transverse to current flow and predict antenna loading in the presence of plasma. Antennas of arbitrary cross section are analyzed above ground planes of arbitrary shape. Results from the antenna design code (ANDES) are presented and compared to experimental results.

42813 **KrF for fusion: An overview of laser issues.** Jensen, R.J. (Univ. of California, Los Alamos National Lab., P.O. Box 1663, MS A114, Los Alamos, NM 87545). *Fusion Technology;* **11**: No. 3, 481-485(May 1987).

An overview of KrF laser issues for fusion in the laboratory environment is presented. In this fusion method, lasers are used to compress the deuterium-tritium fuel in the pellet to several thousand times its initial density. Krypton-fluoride lasers offer favorable wavelength, bandwidth, pulse-shaping, efficiency, and high-repetition rate properties for achieving fusion. Large-scale demonstration plants for fusion, however, rely on the improvement or resolution of significant issues: front-end capabilities, amplifiers and amplifier scaling, optical engineering for the ultraviolet, alignment systems, kinetics, beam quality, target coupling, cost, and overall system factors. The authors feel that KrF lasers may be able to meet the required inertial confinement fusion driver characteristics, driver-target coupling particularities, and capsule physics issues necessary to produce net energy release from the fusion reaction.

42814 **Aurora multikilojoule KrF laser system prototype for inertial confinement fusion.** Rosocha, L.A.; Hanlon, J.A.; Mc Leod, J.; Kang, M.; Kortegaard, B.L.; Burrows, M.D.; Bowling, P.S. (Univ. of California, Los Alamos National Lab., P.O. Box 1663, MS E548, Los Alamos, NM 87545). *Fusion Technology;* **11**: No. 3, 497-531(May 1987).

Aurora is the Los Alamos National Laboratory short-pulse, high-power, KrF laser system. It serves as an end-to-end technology demonstration for large-scale ultraviolet laser systems of interest for short wavelength, inertial confinement fusion (ICF) investigations. The systems is a prototype for using optical angular multiplexing and serial amplification by large electron-beam-driven KrF laser amplifiers to deliver stacked, 248-nm, 5-ns duration multikilojoule laser pulses to ICF targets using an —1-km-long optical beam path. The entire Aurora KrF laser system is described and the design features of the following major system components are summarized: front-end lasers, amplifier train, multiplexer, optical relay train, demultiplexer, target irradiation apparatus, and alignment and controls systems.

42815 **Use of incoherence to produce smooth and controllable irradiation profiles with KrF fusion lasers.** Lehmberg, R.H.; Goldhar, J. (US Naval Research Lab., Washington, DC 20375). *Fusion Technology;* **11**: No. 3, 532-541(May 1987).

A technique called echelon-free induced spatial incoherence is proposed for producing smooth, controllable target beam profiles with large KrF fusion lasers. The idea is basically an image protection technique that projects the desired time-averaged spatial profile F(x) onto the target via the laser system, using partially coherent broadband light. The information needed to reproduce F(x) is transported through the system by a multitude of independent coherence zones, whose diameters are small compared to scalelengths of linear aberration and gain nonuniformities; as a result, F(x) remains relatively insensitive to these effects. An analysis is carried out to evaluate the pertubations of F(x) due to linear aberration, self-focusing, gain saturation, and diffraction. It shows that under conditions applicable to large KrF lasers, the pertubations will result in a small broadening and smoothing of F(x), whose functional form should be controllable to within a few percent. The ability of this technique to generate smooth focal profiles is demonstrated using a small KrF discharge oscillator-preamplifier system.

42816 **KrF laser optimization.** Czuchlewski, S.J.; Hanson, D.E.; Krohn, B.J.; Larson, A.R.; Salesky, E.T. (Univ. of California, Los Alamos National Lab., Los Alamos, NM 87545). *Fusion Technology;* **11**: No. 3, 560-575(May 1987).

The optimization of a 10-kJ large aperture (1-X 1-m) electron-beam-pumped KrF laser is investigated theoretically. Model calculations in zero and one dimension have been performed over extensive ranges in a few parameters for optimization of output fluence. A practical procedure for one-dimensional modeling is given, and significant differences between calculations performed in zero and one dimension are discussed. Predictions are compared to preliminary experimental results. The model is then applied to a regime of much higher electron energy deposition and total gas pressure. Some aspects of the operation of such a laser are discussed. Applications to inertial confinement fusion are described.

42817 **Electron-beam sources for pumping large aperture KrF lasers.** Rosocha, L.A.; Riepe, K.B. (Univ. of California, Los Alamos National Lab., P.O. Box 1663, MS E548, Los Alamos, NM 87545). *Fusion Technology;* **11**: No. 3, 576-611(May 1987).

Krypton-fluoride lasers have been shown to be promising candidates for inertial confinement fusion (ICF) drivers. These lasers can be effectively pumped with electrical discharges or energetic electron beams (e beams). With discharge pumping, the laser aperture is limited in size to a few centimetres (at atmospheric pressure) because of discharge instabilities that cause a homogeneous discharge to degenerate into arcs. Much larger aperature lasers can be pumped using relativistic e beams. At Los Alamos National Laboratory (LANL) the authors are constructing high-energy e-beam-driven KrF lasers with apertures as large as 1 m/sup 2/ for the ICF program. In designing and building these lasers, a number of physics and engineering issues related to large area electron guns (e guns) must be addressed. Among these issues are the following: generation of the relativistic e beams, transport of the e beams into the laser gas, and design and construction of pulsed power devices for driving the e guns.

42818 **Aurora inertial confinement fusion laser control and data acquisition system.** Bowling, P.S.; Burczyk, L.; Dingler, R.D.; Shurter, R.B. (Los Alamos National Lab., P.O. Box 1663, AT-8 MS H811, Los Alamos, NM 87545). *Fusion Technology;* **11**: No. 3, 612-623(May 1987).

Aurora is a complex krypton fluoride excimer research laser supported by a computerized control and data acquisition system. Aurora's requirements for control, data aquisition, and data analysis are met with specific application of minicomputer and microcomputer capabilities coupled with internally developed custom hardware and software. A control system that provides an operator with the ability to charge and fire the integrated laser system safely and remotely is described. A data aquisition system that acquires, stores, and processes laser system data is also described. This data acquisition system provides the experimentalists with support tools for better understanding the laser system.

42819 **Beam propagation considerations in the Aurora laser system.** Rosoche, L.A.; Mc Leod, J.; Hanlon, J.A. (Univ. of California, Los Alamos National Lab., P.O. Box 1663, MS E548, Los Alamos, NM 87545). *Fusion Technology;* **11**: No. 3, 624-633(May 1987).

Aurora is a high-power KrF laser system now being constructed for inertial confinement fusion (ICF) studies. It will use optical angular multiplexing and serial amplification by electron-beam-driven KrF amplifiers to deliver a stacked, multikilojoule 5-ns-duration laser pulse to ICF targets. The requirements of angular multiplexing KrF lasers at the multikilojoule level dictate path lengths on the order of 1 km. The inherent complicated path crossings produced by angular multiplexing and pulse stacking do not allow isolation of individual beam lines, so the optical quality of the long beam paths must be controlled. Propagation of the 248-nm light beams over long paths in air is affected by scattering, absorption thermal gradients and turbulence, beam alignment, and control and optical component figure errors.

42820 **Aurora laser optical system.** Hanlon, J.A.; Mc Leod, J. (Los Alamos National Lab., P.O. Box 1663, MS E548, Los Alamos, NM 87545). *Fusion Technology;* **11**: No. 3, 634-653(May 1987).

The Los Alamos National Laboratory KrF Aurora laser optical system is described. Conceptual, first-order, and detailed designs are presented for the major 248-nm ultraviolet optical, subsystems. In Aurora, a 5-ns front-end pulse is replicated and time encoded into a 96-beam, 480-ns pulse train, angle encoded, amplified, and then time and angle decoded so that all the 5-ns pulses arrive at the target plane simultaneously. The encoder and the centered optical system that directs the pulse train through the amplifiers have been installed, on major alignment system has been built and tested, and most decoder optical components have been designed and ordered. The plan is to have the entire optical system installed and initial integration completed by October 1987.

42821 **PAC-MAN, A precision alignment control system for multiple laser beams self-adaptive through the use of noise.** Kortegaard, B.L. (Los Alamos National Lab., P.O. Box 1663, Los Alamos, NM 87545). *Fusion Technology;* **11**: No. 3, 671-683(May 1987).

A control system is described that aligns the 96 beams of the Aurora KrF laser system to within a pointing accuracy of 5 μrad within 5 min and maintains the alignment in real time. This performance is made possible through a novel use of random noise. The 96 beams, together with optical benchmarks, are imaged on a single television (TV) camera. The pointing angles of those beams are estimated from the arithmetic means of the pixel coordinates within the beam images. The pixel intensities of each TV frame are mapped into a binary decision array based on whether or not the pixel intensity is above or below a threshold criterion. Existing, or introduced, random noise in the TV signal causes the contents of

this array to vary from frame to frame, even when the actual beam is stationary. The beam positions are estimated from the pixel coordinates and their associated elements within this array. Finally, the beam angle estimates are updated from these position estimates, each TV frame, in combination with all previous estimates.

42822 **Design of a 100-kJ KrF power amplifier module.** Sullivan, J.A. (Los Alamos National Lab., P.O. Box 1663, Los Alamos, NM 87545). *Fusion Technology;* **11**: No. 3, 684-704(May 1987).

The technology required to advance the state of the art of KrF amplifier construction to the 100-k-J output beam level is identified. The design of a non-lasing prototype machine that would test the soundness of the expanding flow diode concept and the viability of a modular and stackable approach to the electron guns and power supplies for very large amplifiers is presented and discussed in detail. The preliminary design of a 100-kJ power amplifier module is described, and key design problems and approaches are discussed. The realization of the technologies identified wold lay the foundation for the construction of national facilities for the study of laser fusion at a near-optimum wavelength.

42823 **Future developments and applications of KrF laser-fusion systems.** Harris, D.B.; Kurnit, N.A.; Lowenthal, D.D.; Berger, R.G.; Eggleston, J.M.; Ewing, J.J.; Kushner, M.J.; Waganer, L.M.; Bowers, D.A.; Zuckerman, D.S. (Los Alamos National Lab., P.O. Box 1663, MS F611, Los Alamos, NM 87545). *Fusion Technology;* **11**: No. 3, 705-731(May 1987).

Two different types of KrF lasers currently being analyzed as potential laser-fusion drivers: large electron-beam (e-beam)-pumped amplifiers using pure optical multiplexing for pulse compression and small e-beam sustained discharge lasers using a hybrid pulse compression technique. Both types of KrF lasers appear able to satisfy all of the requirements for commercial-applications ICF drivers, including cost, efficiency, pulse shaping, energy scaling, repetition rate, reliability, and target coupling. The KrF driver can effectively operate at efficiencies $> 10\%$ and can contribute < 10 mill/kWh to the cost of electric power production, with the total estimated cost of electricity from either KrF laser system being comparable (25 to 50 mill/kWh, 1985 dollars) with the cost from other methods of electric power production. The Aurora facility is described.

42824 (SAND—86-1514-Vol.11-No.-1, pp 20-23) **Man-made sun: magnetic fusion technology.** Apr 1987. NTIS, PC A04/MF A01. File Number DE87009977.

In Sandia technology: Volume 11, No. 1.

Energy release from the fusion of deuterium and tritium nuclei continues to promise an environmentally attractive energy source. Fusion physics is actively studied in many countries on large experimental facilities, notably the tokamak, reverse pinch, and mirror machines. Several aspects of fusion energy are under study at Sandia. These include the interaction of plasma with material surfaces, research on the behavior of tritium in solids, and the developmental of special materials. Research emphasis is on questions about materials and processes in high-heat-flux areas of the reactor. The feasibility of this technology is discussed.

42825 **U.S. contribution to the Phase 2A, Part 2 International Tokamak Reactor Workshop, 1983-1985, June 1985.** Stacey, W.M. Jr.; Baker, C.C.; Colestock, P.L.; Flanagan, C.A.; Mattas, R.F.; Peng, Y.K.M.; Post, D.E.; Smith, D.L.; Spampinato, P.T.; Thome, R.J. (Georgia Institute of Technology, Nuclear Engineering and Health Physics Program, Atlanta, GA). *Fusion Technology;* **11**: No. 2, 317-345(Mar 1987).

Critical technical issues that affect the feasibility of the International Tokamak Reactor (INTOR) concept for a next-generation tokamak experimental reactor are analyzed. The results of these studies are used to update the recommended design concept for INTOR.

42826 **The radiological hazards of magnetic fusion reactors.** Fetter, S. (Lawrence Livermore National Lab., Livermore, CA 94550). *Fusion Technology;* **11**: No. 2, 400-415(Mar 1987).

The hope that fusion reactors will have fewer radiological hazards than competing fission technologies is an important rationale for fusion research. The possibility of achieving maximum reductions of hazard is explored by analyzing the effects of relatively minor modifications of the MARS design.

42827 **Eddy currents in a nonperiodic vacuum vessel induced by axisymmetric plasma motion.** De Lucia, J. (Plasma Physics Lab., Princeton Univ., P.O. Box 451, Princeton, NJ 08544). *Fusion Technology;* **11**: No. 2, 429-435(Mar 1987).

A method is described for calculating the two-dimensional trajectory of a vertically or horizontally unstable axisymmetric tokamak plasma in the presence of a resistive vacuum vessel. The vessel is not assumed to have toroidal symmetry. The plasma is represented by a current-filament loop that is free to move vertically and to change its major radius. Its position is evolved in time self-consistently with the vacuum vessel eddy currents. The plasma current, internal inductance, and poloidal beta can be specified functions of time so that eddy currents resulting from a disruption can be modeled.

42828 **Large excimer lasers for fusion.** Jensen, R.J. (Los Alamos National Lab., Los Alamos, NM 87545). pp 15-17 of Excimer lasers and optics. Luk, T.S. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-8609127—).

From SPIE symposium on optics and optoelectronics; Cambridge, MA, USA (14 Sep 1986).

Important goals in DOE and DoD programs require multi-megajoule laser pulses. For inertial confinement fusion there is also a requirement to deliver the pulse in about 25 nsec with a very particular power vs time profile-all at high overall efficiency and low cost per joule. After exhaustive consideration of various alternatives, the author's studies have shown that the most cost effective approach to energy scaling is to increase the size of the final amplifiers up to the 200 to 300 kJ level. This conclusion derives largely from the fact that, at a given complexity, costs increase slowly with increasing part size while output energy should increase dramatically. Extrapolations to low cost by drastic cuts in the unit cost of smaller devices through mass production are considered highly risky. At a minimum the requirement to provide, space, optics and mounts for such systems will remain expensive. In recent years there have been dramatic advances in scaling. The Los Alamos LAM has produced over 10 kJ in a single 1/2 nsec pulse. In this paper the author explores the issues involved in scaling to higher energy while still maintaining high efficiencies. In the remainder of this paper the author discusses KrF laser scaling for the fusion mission.

42829 **Volatility of V15Cr5Ti fusion reactor alloy.** Neilson, R.M. Jr. (Idaho National Engineering Lab., Idaho Falls). *Journal of Nuclear Materials;* **141-143**: No. B, 607-610(Nov-Dec 1986). (CONF-860421—). Contract AC07-76ID01570.

From 2. international conference on fusion reactor materials (ICFRM-2); Chicago, IL, USA (13 Apr 1986).

One potential hazard from the presence of activation products in fusion facilities is accidental oxidation-driven volatilization of those activation products. Scoping experiments were conducted to investigate the oxidation and elemental volatility of candidate first wall/blanket structural alloy V15Cr5Ti as a function of time, temperature, and test atmosphere. Experiments in air and in argon carrier gases containing 10^4 to 10^1 Pa (10^{-1} to 10^{-4} atm) oxgen were conducted to investigate the lower oxygen partial pressure limit for the formation of a low melting point (approximately 650°C), high volatility, oxide layer and its formation rate. Experiments were also performed to determine the elemental volatility of alloy constituents in air at temperatures of 700°C to greater than 1600°C. Some of these volatility experiments used V15Cr5Ti that was arc-remelted to incorporate small quantities (<0.1 wt%) of scandium and calcium which account for the majority of the radiological importance of the activated alloy in potential accidents.

42830 **Microstructural evolution in an austenitic stainless steel fusion reactor first wall.** Stoller, R.E.; Odette, G.R. (Oak Ridge National Lab., TN; California Univ., Santa Barbara). *Journal of Nuclear Materials;* **141-143**: No. B, 647-653(Nov-Dec 1986). (CONF-860421—). Contract AC05-84OR21400;AA03-76SF00034.

From 2. international conference on fusion reactor materials (ICFRM-2); Chicago, IL, USA (13 Apr 1986).

The design of near-term fusion reactors will require the extrapolation of radiation effects data which have been generated in fast fission reactors. A detailed rate-theory-based model of microstructural evolution under fast neutron irradiation has been developed to aid in this interpretation. The prominent new feature of this model is the treatment of dislocation evolution. Frank faulted loops form, grow, and unfault to provide a source for network dislocations while the dislocation network is simultaneously evolving. The dislocation evolution model has been coupled with a previously developed cavity swelling model. The predictions of this composite model compare favorably with fast reactor microstructural data over a broad range of irradiation temperatures and doses. The composite model has been used to predict the microstructural evolution in a DT fusion reactor first wall. The predicted network dislocation densities are generally somewhat lower for the fusion case. However, the major effects of the higher fusion He/dpa ratio are a reduced incubation time for swelling and enhanced swelling at low temperatures.

42831 **Effect of irradiation temperature and oxygen impurity on the yield strength of T(d,n) neutron irradiated niobium.** Bradley, E.R.; Jones, R.H. (Battelle Pacific Northwest Labs., Richland, WA). *Journal of Nuclear Materials;* **141-143**: No. B, 686-689(Nov-Dec 1986). (CONF-860421—). Contract AC06-76RL01830.

From 2. international conference on fusion reactor materials (ICFRM-2); Chicago, IL, USA (13 Apr 1986).

Tensile tests and microstructural examinations have been conducted on niobium wires and foils with differing oxygen contents following irradiation with T(d,n) neutrons (14.8 MeV) at 300 K, 475 K, and 675 K. The yield strength of the irradiated wires was strongly dependent on both oxygen content and irradiation temperature. Increasing the oxygen content from 185 to 480 wppm produced 1.6 to 2.0 times greater increases, $\Delta\sigma$, in the measured yield strength for samples irradiated at the same temperature of a fluence of proportional to $5x10^{21}$ m^{-2}. Maximum strengthening was observed following irradiation at 475 K where the measured yield strength increases were at least a factor of 3 greater than for samples with similar oxygen contents irradiated at 300 K. Irradiation at 675 K produced 30 to 60% more strengthening at $5x10^{21}$ m^{-2} than irradiation at 300 K. Correlations between the measured yield strength and microstructural data suggest that oxygen impurities interact with the irradiation produced defects during irradiation at 475 K, resulting in more effective obstacles to dislocation motion and consequently greater strengthening.

42832 **Blanket material and engineering issues, and requirements for experiments and facilities.** Abdou, M.A.; Gierszewski, P.; Tillack, M.S.; Raffray, A.R.; Sze, D.K.; Puigh, R. (California Univ., Los Angeles; Argonne National Lab., IL; Westinghouse Hanford Co., Richland, WA). *Journal of Nuclear Materials;* **141-143**: No. A, 10-18(Nov-Dec 1986). (CONF-860421—). Contract FG03-86ER52123.

From 2. international conference on fusion reactor materials (ICFRM-2); Chicago, IL, USA (13 Apr 1986).

Fusion nuclear technology components face a new and tougher environment than experienced but any previous nuclear application. The development of feasible and attractive fusion nuclear components will require a broad research effort including experiments, model development and innovative designs. In order to provide an efficient strategy, the important issues must be identified and characterized, and required experiments and facilities must be defined. This paper considers the experiments needed to solve the uncertainties associated with liquid breeder and solid breeder blankets. Many of these uncertainties are strongly material-related and involve a number of areas ranging from basic material properties under irradiation to highly interactive phenomena involving several materials, components and/or environmental conditions. They can be addressed in a number of progressively more integrated experiments. Test facilities to investigate these uncertainties range from simple bench-top experiments, to large non-nuclear tests, fission reactors and point neutron sources, and fusion test facilities. Possible experiments and facilities have been analyzed in a timeframe consistent with the present US goal of supporting an assessment of the feasibility and attractiveness of fusion around the year 2000.

42833 **Oxidation/volatilization rates in air for candidate fusion reactor blanket materials, PCA and HT-9.** Piet, S.J.; Kraus, H.G.; Neilson, R.M. Jr.; Jones, J.L. (Idaho National Engineering Lab., Idaho Falls). *Journal of Nuclear Materials;* **141-143**: No. A, 24-28(Nov-Dec 1986). (CONF-860421—). Contract AC07-76ID01570.

From 2. international conference on fusion reactor materials (ICFRM-2); Chicago, IL, USA (13 Apr 1986).

Large uncertainties exist in the quantity of neutron-induced activation products that can be mobilized in potential fusion accidents. The accidental combination of high temperatures and oxidizing conditions might lead to mobilization of a significant amount of activation products from structural materials. Here, the volatilization of constituents of PCA and HT-9 resulting from oxidation in air was investigated. Tests were conducted in flowing air at temperatures from 600 to 1300°C for 1, 5, or 20 h. Elemental volatility was calculated in terms of the weight fraction of the element volatilized from the initial alloy. Molybdenum and manganese were the radiologically significant primary constituents most volatilizized, suggesting that molybdenum and manganese should be minimized in fusion steel compositions. Higher chromium content appears beneficial in reducing hazards from mobile activation products. Scanning electron microscopy and energy dispersive spectroscopy were used to study the oxide layer on samples.

42834 **Near term and long term materials issues and development needs for plasma interactive components.** Mattas, R.F. (Argonne National Lab., IL). *Journal of Nuclear Materials;* **141-143**: No. A, 29-37(Nov-Dec 1986). (CONF-860421—).

From 2. international conference on fusion reactor materials (ICFRM-2); Chicago, IL, USA (13 Apr 1986).

Also published as report CONF—860421-43.

Plasma interactive components (PICs), including the first wall, limiter blades, divertor collector plates, halo scrapers, and RF launchers, are exposed to high particle fluxes that can result in high sputttering erosion rates and high heat fluxes. In addition, the material in reactors are exposed to high neutron fluxes which will degrade the bulk properties. This severe environment will limit the materials and designs which can be used in fusion devices. In order to provide a reasonable degree of confidence that plasma interactive components will operate successfully, a comprehensive development program is needed. Materials research and development plays a key role in the successful development of PICs. The range of operating conditions along with a summary of the major issues for materials development is described. The areas covered include plasma/materials interactions, erosion/redeposition, baseline materials properties, fabrication, and irradiation damage effects. Candidate materials and materials development needs in the near term and long term are identified.

42835 **Ceramic electrical insulators for liquid metal blankets.** Liu, Y.Y.; Smith, D.L. (Argonne National Lab., IL). *Journal of Nuclear Materials;* **141-143**: No. A, 38-43(Nov-Dec 1986). (CONF-860421—).

From 2. international conference on fusion reactor materials (ICFRM-2); Chicago, IL, USA (13 Apr 1986).

A systematic evaluation of ceramic electrical insulators for a self-cooled, liquid-lithium/vanadium-alloy blanket has been conducted to identify the most promising condidates as well as the data needs. Fifteen oxides and nitrides are included in this evaluation; all of them have been assessed against a common set of technical requirements, low activation and cost. Among these materials, CaO, MgO, BN, and Y_2O_3 appear to be the most promising candidates for insulator coating, whereas all of these four materials, plus $MgAl_4O_4$, $Y_3Al_5O_{12}$, and AlN, may be used as laminated insulators. Important issues for these candidates are stability in high-purity liquid lithium and stability under neutron and γ-photon irradiations.

42836 **Costs and benefits of utilizing beryllium as an energy multiplier.** Klein, A.C.; Sze, D.K. (Oregon State Univ., Corvallis; Argonne National Lab., IL). *Journal of Nuclear Materials;* **141-143**: No. A, 61-64(Nov-Dec 1986). (CONF-860421—).

From 2. international conference on fusion reactor materials (ICFRM-2); Chicago, IL, USA (13 Apr 1986).

The potential use of large amounts of beryllium of energy multiplication in a fusion reactor blanket is evaluated. The primary problems associated with the use of beryllium are the resource limitations and radiation induced swelling. The chief benefit of increasing the energy multiplication of the blanket is the additional amount of power which is obtained. It is found that the costs associated with the addition of large amounts of beryllium to the blanket are less than the benefits obtained, resulting in a reduction in the cost of eletricity for a reactor system utilizing beryllium by 12% when compared to a more traditional blanket design.

42837 **Safety and environmental challenges in materials selection.** Piet, S.J. (Idaho National Engineering Lab., Idaho Falls). *Journal of Nuclear Materials;* **141-143**: No. A, 65-72(Nov-Dec 1986). (CONF-860421—). Contract AC07-76ID01570.

From 2. international conference on fusion reactor materials (ICFRM-2); Chicago, IL, USA (13 Apr 1986).

The single most significant factor determining the safety and environmental characteristics of a fusion power plant is the choice of near-plasma materials. The three purposes of the paper are to (a) very briefly summarize the key safety issues, (b) examine the current state of knowledge concerning which elements and material compositions appear to be the best selections from the safety perspective, and (c) provides some thoughts on future directions in materials research and selection. With the most conventional materials currently being pursued, it is likely that an attractive fusion energy source will be possible. However, it is also likely that further innovation can lead to superior materials. Enough is known to provide guidance on future directions so as to help fulfill fusion's highest potential. Preferred materials include helium, lithium, and flibe ($LiF\text{-}BeF_2$) as coolants; certain ceramics, lithium, and flibe as tritium breeders; silicon carbie, vanadium alloys, and clean ferritic steels as structural materials.

42838 **Potential applications of NbN composites in fusion reactor magnets.** Capone, D.W. II; Gray, K.E.; Kampwirth, R.T.; Ho, H.L. (Argonne National Lab., IL). *Journal of Nuclear Materials;* **141-143**: No. A, 73-75(Nov-Dec 1986). (CONF-860421—).

From 2. international conference on fusion reactor materials (ICFRM-2); Chicago, IL, USA (13 Apr 1986).

Also published as report CONF—860421-38.

This paper describes the present status and future directions of the ANL program for the potential applications of NbN composites in fusion reactor magnets.

42839 **Corrosion- and irradiation-induced porosity changes of a nuclear graphitic material.** Hoinkis, E.; Eatherly, W.P.; Krautwasser, P.; Robens, E. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H., Germany, F.R.; Oak Ridge National Lab., TN; Kernforschungsanlage Juelich G.m.b.H., Germany, F.R.; Battelle-Institut e.V., Frankfurt am Main, Germany, F.R.). *Journal of Nuclear Materials;* **141-143**: No. A, 87-95(Nov-Dec 1986). (CONF-860421—).

From 2. international conference on fusion reactor materials (ICFRM-2); Chicago, IL, USA (13 Apr 1986).

In pristine specimens of a nuclear grade graphitic material the volume of accessible pores with diameters <0.1 μm is much smaller (0.9 mm^3g^{-1}) than the total accessible pore volume (82 mm^3g^{-1}) but the former increased with corrosion much more than the latter (36 and 160 mm^3g^{-1}, respectively, at a burn-off = 5 wt%). The specimens were oxidized by CO_2 at 900°C. Independent of burn-off the most frequent pore diameter is proportional to 2 nm, as was determined form N_2 adsorption isotherms at 77K. Corrosion leads also to a pronounced increase in pores in the range 2-5 nm and in the apparent BET surface area from 0.6 m^2g^{-1} (pristine) to 39 m^2g^{-1} (burn-off = 5 wt%). The analysis of small angle X-ray scattering (SAXS) curves revealed that at the beginning of corrosion the existing 1 nm pores are enlarged. Additional micropores are developed with further burn-off. A neutron fluence of $5 \cdot 10^{21}$ cm^{-2} EDN (equivalent to about 7 dpa) at 950°C caused a marked increase in the volume of pores with 2.5 nm diameter. From a comparison of the SAXS results with the data obtained by xylene impregnation and N_2 adsorption it was concluded that most of the pores generated by irradiation are accessible to gases.

42840 **Graphite sublimation and hydrocarbon production due to intense energy deposition.** Croessmann, C.D.; Whitley, J.B.; Kulcinski, G.L. (Sandia National Labs., Albuquerque, NM; Wisconsin Univ., Madison). *Journal of Nuclear Materials;* **141-143**: No. A, 108-112(Nov-Dec 1986). (CONF-860421—).

From 2. international conference on fusion reactor materials (ICFRM-2); Chicago, IL, USA (13 Apr 1986).

The thermal response of Poco AXF5Q graphite to intense energy deposition was studied using the Electron Beam Test System at Sandia National Laboratories. The carbon sublimation caused by these heat loads was measured and the subsequent surface modifications showed preferential sublimation due to inhomogeneous regions in the graphite. Hydrocarbon production was monitored with an RGA system with the quantities of water, acetylene, methane and heavier hydrocarbons measured as a function of time during the energy deposition tests. Several samples were used for multiple tests, resulting in a study of hydrocarbon production as a funcion of number of thermal cycles. The hydrocarbon production did not diminish appreciably after 10 shots, suggesting that the observed hydrocarbon production comes from the bulk rather than the surface.

42841 **Outgassing of AXF-5Q and other grades of limiter graphites.** Pontau, A.E.; Morse, D.H. (Sandia National Labs., Livermore, CA). *Journal of Nuclear Materials;* **141-143**: No. A, 124-130(Nov-Dec 1986). (CONF-860421—).

From 2. international conference on fusion reactor materials (ICFRM-2); Chicago, IL, USA (13 Apr 1986).

During the high power tokamak discharge, graphite limiter surfaces may reach temperatures greater than 2000°C. The underlying material also experiences smaller temperature excursions. One result is that volatile compounds are introduced into plasmas from the limiters. An expensive tokamak conditioning period extending over weeks of discharge cleaning and hundreds of high power shots may be required to obtain acceptably clean plasmas. In general, graphite components are given a bake-out treatment prior to installation to reduce the conditioning period. In order to select appropriate graphites and determine bake-out and handling procedures for given applications, we have conducted outgassing experiments for several candidate graphites. We heat small samples of different types of graphite to >1500°C using high intensity quartz lamps and find that significant amounts of impurities are desorbed. Hydrogen, carbon, and oxygen make up the various compounds observed. Absolute levels are determined by graphite type and prior air exposure and heat treatment.

42842 **Promising copper alloys for high heat load applications in neutron environments.** Livak, R.J.; Frost, H.M.; Zocco, T.G.; Kennedy, J.C.; Hobbs, L.W. (Los Alamos National Lab., NM). *Journal of Nuclear Materials;* **141-143**: No. A, 160-162(Nov-Dec 1986). (CONF-860421—).

From 2. international conference on fusion reactor materials (ICFRM-2); Chicago, IL, USA (13 Apr 1986).

Four candidate copper alloys and two elemental coppers were irradiated in the Experimental Breeder Reactor to damage levels of about 3 and 15 dpa at 385°C. The irradiated and control samples were evaluated to determine swelling, room temperature tensile properties, transmutation product levels, and electrical resistivity. Transmission electron microscopy was used to characterize the damaged microstructures. Among the six materials studied, the alumina-dispersed copper alloys (Glidcop A1-20 and A1-60 sheet materials) exhibited the best, overall resistance to fast neutron damage as they had minimal swelling and retained their original values of yield strength and electrical resistivity (corrected for transmuted elements) after irradiation. The two cold-worked and age-hardened alloys (AMZIRC and MZC) suffered loss of yield strength after irradiation at 385°C. The two elemental coppers and the AMZIRC alloy showed large swelling (3.6-6.8 vol%) due to

void formation after the high neutron fluence. Further study is needed to understand microstructural alterations caused by neutron damage of the alumina-dispersed copper alloy.

42843 **Porosity swelling and transmutation contributions to conductivity changes in some neutron-irradiated copper alloys.** Frost, H.M.; Kennedy, J.C. (Los Alamos National Lab., NM). *Journal of Nuclear Materials;* **141-143**: No. A, 169-173(Nov-Dec 1986). (CONF-860421—).

From 2. international conference on fusion reactor materials (ICFRM-2); Chicago, IL, USA (13 Apr 1986).

Fast-neutron irradiation of alloys for fusion-reactor applications produces bulk changes in the density and composition via porosity swelling and transmutation which affect the dc volume electrical and thermal conductivities ($\sigma = 1/\text{rho/sub e/}$ and K). For the Cu materials of our study, neutron fluences of 2×10^{26} n/m^2 (E>0.1 MeV) produced increases in Ni and Zn concentrations of about 0.05 and 0.09 wt%, respectively, and porosity swelling of 0-7%; rho/sub e/ accordingly increased as much as 18%. We also determined the individual rho/sub e/ changes due to both swelling and transmutation via use of an appropriate mixing rule and of Matthiessen's law to unmask any residual effects present, e.g., phase or microstructural changes. For four materials - two pure copper and two alumina-dispersion-strengthened (ADS) alloys - subtraction of these δrho/sub e/'s from the irradiated values yielded or nearly yielded the respective control values. In contrast, the two precipitation-strengthened (PS) alloys studied, MZC and AMZIRC, had relatively large negative residues, apparently indicating effective radiation-induced conductivies.

42844 **Recent results on the preparation and properties of Li-containing Cu alloys.** Mendelsohn, M.H.; Gruen, D.M.; Krauss, A.R. (Argonne National Lab., IL). *Journal of Nuclear Materials;* **141-143**: No. A, 184-187(Nov-Dec 1986). (CONF-860421—).

From 2. international conference on fusion reactor materials (ICFRM-2); Chicago, IL, USA (13 Apr 1986).

Also published as report CONF—860421-46.

Copper lithium alloys are of interest in fusion applications because of their previously observed capability of forming self-sustaining secondary-ion emitting lithium overlayers on predominantly copper substrates. Large quantities (up to 250 g) of material containing up to about 12 at% Li have been successfully prepared by melting samples in boron nitride crucibles in a resistance heated furnace. In order to obtain a uniform lithium concentration, remelting or annealing treatments are necessary. Metallographic examination has revealed that single-phase homogeneous alloys exist only up to a concentration of about 8 at %Li. However, the thermodynamic stability of these solid solutions has not been determined. Preliminary studies have been performed on the color changes observed upon reaction of these alloys with gaseous oxygen at elevated temperatures.

42845 **Radiation-enhanced recrystallization in copper alloys.** Zinkle, S.J.; Mansur, L.K.; Kulcinski, G.L. (Oak Ridge National Lab., TN; Wisconsin Univ., Madison). *Journal of Nuclear Materials;* **141-143**: No. A, 188-192(Nov-Dec 1986). (CONF-860421—). Contract AC05-84OR21400.

From 2. international conference on fusion reactor materials (ICFRM-2); Chicago, IL, USA (13 Apr 1986).

Two high-strength copper alloys, cold-worked and aged AMZIRC (Cu-Zr) and AMAX-MZC (Cu-Cr-Zr-Mg), were irradiated with 14-MeV Cu ions to a damage level of 10 dpa at temperatures of 100 to 500°C. Cross-section examination of the irradiated foils using electron microscopy revealed signs of radiation-enhanced recrystallization for irradiation temperatures above 300°C. The recrystallization temperature for both alloys is about 450°C during thermal annealing for a time similar to the ion-irradiation time -1.5 h. A simplified analysis of the results suggests that the accelerated recrystallization kinetics is due to radiation-enhanced diffusion (RED). This process may restrict the maximum operating temperature of fusion reactor components that incorporate these types of alloys to temperatures as low as 200°C.

42846 **Ion debris and X-ray energy deposition and response of fusion reactor first walls.** Hassanein, A.M.; Attaya, H.M.; Kulcinski, G.L. (Argonne National Lab., IL; Wisconsin Univ., Madison). *Journal of Nuclear Materials;* **141-143**: No. A, 221-225(Nov-Dec 1986). (CONF-860421—).

From 2. international conference on fusion reactor materials (ICFRM-2); Chicago, IL, USA (13 Apr 1986).

The energy deposition of the thermonuclear target explosion products in Inertial Confinement Fusion (ICF) reactors, i.e., ion debris and X-rays and the resulting thermal response of first wall materials, is calculated using the computer code ATEN. Models to accurately simulate the ion and X-ray energy deposition and the consequent response of the wall are implemented in the code. Simultaneous multiple ions and X-rays with different yields and spectra incident on various wall materials are easy handled by the code. In a laser driven ICF reactor, in addition to X-rays, ions, and neutrons, the first wall will be exposed to the portion of the laser light reflected from the target. This could have an important effect on the overall performance of the wall. The thermal response and the resulting melting and erosion due to vaporization of wall materials are found to be critically dependent on target design configuration. Depending on the details of target design, its constituents and the driver beam, a wide range of X-ray and ion debris yields and spectra can be generated as a result of the thermonuclear reaction. A parametric study of first wall temperature excursion, resulting melt thickness and material loss for different candidate wall materials is presented. It is found that controlling the partition between X-ray energy yield and ion energy yield and their spectra can substantially result in a longer first wall lifetime for the same total target yield.

42847 **Comparison on implantation-driven permeation characteristics of fusion reactor structural materials.** Longhurst, G.R.; Anderl, R.A.; Struttmann, D.A. (Idaho National Engineering Lab., Idaho Falls). *Journal of Nuclear Materials;* **141-143**: No. A, 229-233(Nov-Dec 1986). (CONF-860421—). Contract AC07-76ID01570.

From 2. international conference on fusion reactor materials (ICFRM-2); Chicago, IL, USA (13 Apr 1986).

Implantation-driven permeation experiments have been conducted on samples of the ferritic steel HT-9, the austenitic Primary Candidate Alloy (PCA) and the vanadium alloy V-15Cr-5Ti using D_3^+ ions under conditions that simulate charge-exchange neutral loading on a fusion reactor first wall. The steels all exhibited an initially intense permeation spike followed by an exponential decrease to low steady-state values. That spike was not evident in the V-15Cr-5Ti experiments. Steady-state permeation was highest in the vanadium alloy and lowest in the austenitic steel. Though permeation rates in the HT-9 were lower than those in V-15Cr-5Ti, permeation transients were much faster in HT-9 than in other materials tested. Sputtering of the steel surface resulted in enhanced reemission, whereas in the vanadium tests, recombination and diffusivity both appeared to diminish as the deuterium concentration rose. We conclude that for conditions comparable to those of these experiments, tritium retention and permeation loss in first wall structures made of steels will be less than in structures made of V-15Cr-5Ti.

42848 **FUBR-1B experiment - irradiation of lithium ceramics to high burnups under large temperature gradients.** Hollenberg, G.W.; Knight, R.C.; Densley, P.J.; Pember, L.A.; Johnson, C.E.; Poeppel, R.B.; Yang, L. (Westinghouse Hanford Co., Richland, WA; Argonne National Lab., IL; GA Technologies, Inc., San Diego, CA). *Journal of Nuclear Materials;* **141-143**: No. A, 271-274(Nov-Dec 1986). (CONF-860421—).

From 2. international conference on fusion reactor materials (ICFRM-2); Chicago, IL, USA (13 Apr 1986).

Solid breeder materials used for supplying the tritium for fueling fusion power reactors will be required to withstand a variety of severe environmental conditions such as irradiation damage, thermal stresses and chemical reactions while continuing to produce tritium and not interfering with other essential components in the complex blanket region. In the FUBR-1B experiment, several solid breeder candidates are being subjected to the hostile conditions (i.e., high burnup and large temperature gradients) foreseen in a fusion reactor's blanket. Materials with high lithium atom densi-

ties, such as Li_2O, Li_8ZrO_8 and Li_4SiO_4, and with irradiation stability such as $LiAlO_2$ and Li_2ZrO_3, are being irradiated to high burnup levels and under large temperature gradients.

42849 Elastic and creep properties of Li_2O. Billone, M.C.; Liu, Y.Y.; Poeppel, R.B.; Routbort, J.L.; Goretta, K.C.; Kupperman, D.S. (Argonne National Lab., IL). *Journal of Nuclear Materials;* **141-143**: No. A, 282-288(Nov-Dec 1986). (CONF-860421—).

From 2. international conference on fusion reactor materials (ICFRM-2); Chicago, IL, USA (13 Apr 1986).

The room-temperature elastic properties of relatively high-density (proportional to 90% TD) Li_2O were measured sonically by standard pulse-echo overlap techniques. The Young's modulus, shear modulus, and Poisson's ratio determined from an average of three specimens were $1.08x10^5$ MPa, $4.56x10^4$ MPa, and 0.19, respectively. Based on a review of other ceramics, temperature- and porosity-dependent factors are recommended for extrapolation of these results to higher temperatures and to higher and lower porosity fractions. Scoping tests were conducted using compressive, constant strain rate to investigate the steady-state, thermal creep rate of Li_2O as a function of stress and temperature. The stress was monitored until it reached a steady-state value characteristic of secondary creep. The results to date indicate a stress exponent of 5.5+-0.5 and an apparent activation energy of 260+-50 kJ/mol for temperatures in the range of 700-800°C and stresses in the range of 15-45 MPa. Additional creep tests are in progress to determine the secondary creep behavior of Li_2O at higher and lower temperatures and as a function of stress, temperature, microstructure and moisture content.

42850 Measurements of tritium and helium in fast neutron irradiated lithium ceramics using high temperature vacuum extraction. Baldwin, D.L.; Hollenberg, G.W. (Hanford Engineering Development Lab., Richland, WA). *Journal of Nuclear Materials;* **141-143**: No. A, 305-310(Nov-Dec 1986). (CONF-860421—).

From 2. international conference on fusion reactor materials (ICFRM-2); Chicago, IL, USA (13 Apr 1986).

Tritium and helium retention measurements have been performed at the Hanford Engineering Development Laboratory on fast-neutron-irradiated lithium ceramic materials from solid-breeder closed-capsule test FUBR-1A. The lithium ceramic materials discussed at this time include Li_2O, $LiAlO_2$, and Li_2ZrO_3. The experimental conditions forming the test matrix include ^6Li burnup levels of 1, 2 and 3 at% and irradiation temperatures of 773, 973 and 1173 K, for the three materials. Included will be a discussion of mechanisms controlling tritium retention. The retention measurements reported here were obtained using a rapid, high temperature vacuum extraction method, utilizing newly designed apparatus. This new apparatus will be described, along with developmental supporting data.

42851 Testing needs and experiments for solid breeder blankets. Gierszewski, P.; Puigh, R. (California Univ., Los Angeles; Hanford Engineering Development Lab., Richland, WA). *Journal of Nuclear Materials;* **141-143**: No. A, 311-315(Nov-Dec 1986). (CONF-860421—). Contract AA03-76SF00034.

From 2. international conference on fusion reactor materials (ICFRM-2); Chicago, IL, USA (13 Apr 1986).

Most of the critical issues for solid breeder blankets are related to the tritium and thermomechanical behavior of the solid breeder and multiplier. A major contributor to this uncertainty is the lack of definition of a preferred material, microstructure and form. Material selection and development is particularly cost-effective at present since much of the important blanket behavior is driven by local conditions rather than the overall blanket design, and since the choice of material affects the nature of the later and larger experiments. This stage of testing is also the most appropriate time to consider basic material choices such as sphere-pac or sintered pellet, and the incorporation of multiplier material into the blanket. The major testing needs and experiments are characterized here.

42852 Influence of surface desorption on tritium recovery and inventory in fusion solid breeders. Billone, M.C. (Argonne National Lab., IL). *Journal of Nuclear Materials;* **141-143**: No. A, 316-320(Nov-Dec 1986). (CONF-860421—).

From 2. international conference on fusion reactor materials (ICFRM-2); Chicago, IL, USA (13 Apr 1986).

In previous work, models were developed to describe the roles of bulk diffusion and solubility in tritium recovery and inventory in tritium-breeding ceramics (e.g., Li_2O and $LiAlO_2$) for fusion reactor blankets. These models were tested against the data from closed-capsule (e.g., FUBR-1A) and purge-flow (e.g., TRIO) tests with varying degrees of success, depending on the breeder microstructure and the chemistry of the gas phase in and around the ceramic breeder material. In this paper, the role of surface adsorption/desorption is explored to better understand the conditions under which this mechanism is rate-limiting for tritium release and makes a significant contribution to the tritium inventory. The surface adsorption data for several oxides (e.g., Al_2O_3, Fe_2O_3, TiO_2, ZnO, and SiO_2) are reviewed. A model for chemisorption and physisorption (Type II) of water vapor onto solid surfaces is developed, with the constants in the model chosen to match the Al_2O data. Model predictions are then compared to data from closed- and open-capsule tests.

42853 Studies of surface adsorption on $LiAlO_2$. Fischer, A.K.; Johnson, C.E.; McDaniel, J.A. (Argonne National Lab., IL; Maine Univ., Farmington). *Journal of Nuclear Materials;* **141-143**: No. A, 344-347(Nov-Dec 1986). (CONF-860421—).

From 2. international conference on fusion reactor materials (ICFRM-2); Chicago, IL, USA (13 Apr 1986).

Also published as report CONF—860421-47.

Computational and experimental approaches are being taken to understanding surface adsorption/desorption effects on tritium inventory and release. The computational survey integrates a thermodynamic treatment of surface adsorption and bulk phase effects such as solubility and gas phase composition. The system T_2O:T_2:$LiAlO_2$ was examined. The calculations indicate that surface adsorption can be expected to contribute most to tritium inventory under the conditions of lower temperatures and higher oxygen activities. Higher temperature and lower oxygen activity favor lower surface inventory. In the experimental work, a high temperature gas chromatograph was constructed in order to measure the H_2O:H_2 surface adsorption isotherms and the solubility of hydroxide in $LiAlO_2$. Preliminary data indicate that at 478 K approximately 15% of the surface is coverred for a partial pressure of H_2O of approximately 52 Pa. Calculated values can be obtained that are in reasonable agreement with this.

42854 Thermal conductivity of mixed beryllia/Li ceramic in sphere-pac forms. Tam, S.W.; Johnson, C.E. (Argonne National Lab., IL). *Journal of Nuclear Materials;* **141-143**: No. A, 348-352(Nov-Dec 1986). (CONF-860421—).

From 2. international conference on fusion reactor materials (ICFRM-2); Chicago, IL, USA (13 Apr 1986).

Lithium-containing ceramic tritium-breeder materials have been envisaged to be deployed within the blanket region of a fusion reactor in several possible configurations. One of these is the sphere-pac configuration. For this configuration an important material parameter is its thermal conductivity (K/sub sp/). It is well known that K/sub sp/ demonstrates rather complex behavior as a function of temperature, gas pressure, gas composition, particle size, and packing fraction. The interrelationship of these parameters has been satisfactorily accounted for with a hierarchical effective media theory (HEMT). For tritium self sufficiency, most lithium ceramic breeder materials would require the presence of a neutron-multiplier (e.g., Be or BeO). Here, the influence of configuration on K/sub sp/ (i.e., how one put the different solid components together in the sphere-pac bed) becomes important. Using a generalized HEMT (i.e., a model with capability to describe systems with more than one solid material component), we have analyzed in detail the configurational dependence of K/sub sp/ for sphere-pac beds composed of lithium ceramic/BeO microspheres. Substantial improvements in K/sub sp/ can be achieved if a configuration of lithium ceramic spheres coated with BeO is chosen. Increases in K/sub sp/

would lead to enhanced mechanical and thermal performance of the breeder materials.

42855 **Swelling of spinel after low-dose neutron irradiation.** Coghlan, W.A.; Clinard, F.W. Jr.; Itoh, N.; Greenwood, L.R. (Los Alamos National Lab., NM; Nagoya Univ., Japan; Argonne National Lab., IL). *Journal of Nuclear Materials;* **141-143**: No. A, 382-386(Nov-Dec 1986). (CONF-860421—).

From 2. international conference on fusion reactor materials (ICFRM-2); Chicago, IL, USA (13 Apr 1986).

Swelling was determined in samples of single-crystal $MgAl_2O_4$ spinel, irradiated to doses as high as $8x10^{22}$ n/m^2 (E>0.1 MeV) at $\simeq$ 50°C in the Omega West Reactor. Swelling effectively saturated at $\simeq 2x10^{22}$ n/m^2 which corresponds to a damage level of only $\simeq 2x10^{-3}$ dpa. In addition subsequent measurements after irradiation have revealed that the samples continues swelling for several weeks. These results imply that irradiation defects begin to interact by recombination and aggregation at low damage levels in this material at 50°C and perhaps continue to cluster at room temperature after irradiation. Rate equations have been employed to determine defect concentrations at saturation. Results to date show that the observed swelling is consistent with the number of surviving defects if swelling per Frenkel defect pair is taken to be one atomic volume.

42856 **Effects of neutron-irradiation on $MgAl_2O_4$ and Al_2O_3.** Tucker, D.S.; Zocco, T.; Kise, C.D.; Kennedy, J.C. (Georgia Inst. of Tech., Atlanta; Los Alamos National Lab., NM). *Journal of Nuclear Materials;* **141-143**: No. A, 401-404(Nov-Dec 1986). (CONF-860421—).

From 2. international conference on fusion reactor materials (ICFRM-2); Chicago, IL, USA (13 Apr 1986).

Also published in report DOE/ER—0113/5.

Specimens of $MgAl_2O_4$ and Al_2O_3 were irradiated to a neutron fluence of approximately 2 . 10^{26} n/m^2, E > 0.1 MeV at 660 K. Tensile strength was seen to decrease by 25.6% for Al_2O_3 and to increase by 24.4% for $MgAl_2O_4$. Sensity measurements revealed that Al_2O_3 swelled by 3.22% while $MgAl_2O_4$ densified slightly (0.316%). Both exhibited mixed failure modes in both control and irradiated samples with a shift from intergranular to transgranular for $MgAl_2O_4$ and vice-sversa for Al_2O_3 upon irradiation. The $MgAl_2O_4$ damage microstructure consisted of interstitial dislocation loops and denuded grain boundaries. The microstructure of irradiated Al_2O_3 revealed fine areas of damage assumed to be interstitial dislocation loops and voids. Strength and structural changes are correlated with the results and compared with previously obtained results.

42857 **Application of hydrogen embrittlement models to the crack growth behavior of fusion reactor materials.** Jones, R.H. (Battelle Pacific Northwest Labs., Richland, WA). *Journal of Nuclear Materials;* **141-143**: No. A, 468-475(Nov-Dec 1986). (CONF-860421—).

From 2. international conference on fusion reactor materials (ICFRM-2); Chicago, IL, USA (13 Apr 1986).

Also published as report PNL-SA—13478; CONF—860421-51.

Hydrogen induced crack growth rates of a 12 Cr-1 Mo ferritic stainless steel (HT-9) have been estimated for three sources of hydrogen: the plasma, nuclear reactions and aqueous corrosion. Estimates of crack growth rates were derived using hydrogen embrittlement models which describe the temperature and hydrogen activity dependence of cracking. A crack growth rate of 10^{-3} cm/s at a reactor operating temperature of 400°C was obtained for a steady-state hydrogen concentration of 0.5 apm resulting from (n, p) reactions, while a much slower crack growth rate was predicted for the same steady-state hydrogen concentration with an alternate model. These calculations have shown the need for further research to assess the effect of temperature on crack growth. Other sources of hydrogen give very slow hydrogen induced crack growth rates at reactor operating temperatures while significant hydrogen induced crack growth rates are possible at lower temperatures. For instance, hydrogen from an aqueous corrosion reaction could produce a crack growth rate of 10^{-7} cm/s at 25°C which could be significant during extended downtime. Also a non-equilibrium hydrogen uptake from the plasma could occur from surface reaction controlled effects, and a crack growth rate of 10^{-1} cm/s was estimated for this condition at a temperature of 75°C. Based on this analysis, hydrogen induced crack growth is not considered significant for Ht-9 during reactor operation but may be a problem during extended downtime if the temperature decreases to a value less than 100°C.

42858 **Effect of heat treatment and impurity concentration on some mechanical properties of V-15Cr-5Ti alloy.** Loomis, B.A.; Kestel, B.J.; Diercks, D.R. (Argonne National Lab., IL). *Journal of Nuclear Materials;* **141-143**: No. A, 523-526(Nov-Dec 1986). (CONF-860421—).

From 2. international conference on fusion reactor materials (ICFRM-2); Chicago, IL, USA (13 Apr 1986).

Also published as report CONF—860421-36.

The effects of heat treatment and O, N, C, Si, and S impurity level on the yield strength, ductility, and fracture mode for specimens from four different heats of the V-15Cr-5Ti alloy are presented. The heat treatments for the alloy consisted of annealing as-rolled material for one hour at either 950, 1050, 1125, or 1200°C. The total oxygen, nitrogen, and carbon impurity concentration ranged from 0.040 to 0.120 wt%. The Si concentration ranged from 300 to 1050 wppm, and the S concentration ranged from 0.044 to 0.110 wt%. The yield strength and ductility for the alloy, regardless of impurity concentration exhibited minimum and maximum values, respectively, for the 1125°C anneal. The primary mode of failure for the tensile specimens was transgranular ductile fracture.

42859 **Mechanical property measurements on ion-irradiated copper and Cu-Zr.** Zinkle, S.J.; Oliver, W.C. (Oak Ridge National Lab., TN). *Journal of Nuclear Materials;* **141-143**: No. A, 548-552(Nov-Dec 1986). (CONF-860421—).

From 2. international conference on fusion reactor materials (ICFRM-2); Chicago, IL, USA (13 Apr 1986).

A recently developed mechanical properties microprobe (MPM) has been used to investigate strength and elastic modulus changes in ion-irradiated copper and Cu-0.15% Zr (AMZIRC). The indenter load and its displacement are simultaneously monitored while the indentation is being made and also during unloading. The depth dependence of the ion damage was investigated using a cross-section technique. This procedure allows a direct comparison to be made of microhardness data from different irradiation depths while the indent size is held constant. The displacement damage associated with ion irradiation caused either hardening or softening, depending on the irradiation conditions and the material.

42860 **Influence of radiation-induced segregation on ductility of a nickel-silicon alloy.** Packan, N.H.; Schroeder, H.; Kesternich, W. (Oak Ridge National Lab., TN; Kernforschungsanlage Juelich G.m.b.H., Germany, F.R.). *Journal of Nuclear Materials;* **141-143**: No. A, 553-558(Nov-Dec 1986). (CONF-860421—).

From 2. international conference on fusion reactor materials (ICFRM-2); Chicago, IL, USA (13 Apr 1986).

Flat tensile specimens 60 μm thick of Ni-8 at% Si were irradiated to damage levels of 0.1 to 0.3 dpa with either 7 MeV protons or 28 MeV alpha particles at 750 K. The alpha bombarded specimens incurred 750 appm He per 0.1 dpa in the course of their damage-generating irradiation. Radiation-induced silicon segregation gave rise to Ni_3Si layers at internal and external surfaces. Post-irradiation tensile tests conducted either at 300 K or 720 K revealed fully ductile transgranular fractures. There were no significant differences between the proton-bombarded specimens and the unbombarded controls, both exhibiting >25% total elongations, while the alpha-bombarded specimens showed ductile fractures with somewhat lower (17-18%) elongation values probably due to hardening caused by small helium bubbles. Certain specimens that were preimplanted with 250-1000 appm He at 970 K to encourage intergranular failure and expose grain boundaries did fail intergranularly. It is concluded that radiation-induced silicon segregation does not cause intrinsic embrittlement.

99 GENERAL AND MISCELLANEOUS

42861 (BNL—40051) An interactive videodisc system for training. Cadwell, J.J. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 4p. (CONF-870713—40). NTIS, PC A02. File Number DE87013303.

From 28. INMM annual meeting on safeguards: a mature technology; Newport Beach, CA, USA (12 Jul 1987).

Under the sponsorship of the US Department of Energy's Office of Classification (DOE/OC), Brookhaven National Laboratory/Technical Support Organization (BNL/TSO) has prepared a level-three interactive-laserdisc program for the training of authorized classifiers in the Department of Energy. This training program consists of six modules presented in several formats. The material is presented in a highly interactive manner with various tests to reinforce and evaluate the trainee's progress in learning the material. A lengthy qualification test is presented at the end of the educational material. The various instructional techniques of scenario presentation, "talking heads," graphics, textual material and combinations of the above are used to assure that the training material attracts the trainee's interests and motivates him to understand and use the material. The state-of-the-art interactive laser videodisc with its storage capacity, speed flexibility, and superior training capacity was the logical choice for the training of Authorized Classifiers in the Department of Energy.

42862 (DOE/EIA—0205(87/2)) Energy information directory, June 1987. (National Energy Information Center, Washington, DC (USA)). Jun 1987. 96p. NTIS, PC A05/MF A01 - GPO; 1; GPO Dep. File Number DE87013214.

The National Energy Information Center (NEIC) provides energy information and referral assistance to federal, state, and local governments, the academic community, business and industrial organizations, and the general public. The two principal functions related to this task are (1) operating a general access telephone line and (2) responding to energy-related correspondence addressed to the Energy Information Administration (EIA). To assist the NEIC staff, as well as other staff, in directing inquiries to the proper office within DOE or other federal agencies, the Energy Information Directory was developed. This directory is a list of many of the government offices that are involved in energy matters. The offices are classified according to their specialties. Each office has been given an alphanumeric identification symbol (A-01, A-02, etc.). The subject index uses these identification symbols instead of page numbers in referring the reader to relevant entries. Most entries provide an abbreviated office address.

42863 (DP-MS—87-59) The Du Pont commitment to excellence process at the Savannah River site. Joseph, J.W. Jr. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). 1987. Contract AC09-76SR00001. 10p. (CONF-870950—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012389.

From 14. annual national American Society for Quality Control; Las Vegas, NV, USA (14 Sep 1987).

The Commitment to Excellence (CTE) process at the Savannah River Plant and Laboratory is designed to facilitate continuous improvement in the quality of all our activities. This striving for excellence exceeds the definition of quality as "conformance to requirements." The process places high value on the quality of thought of the 8000 Du Pont employees at the site and includes extensive training and team building. The goal is to create an environment that allows every employee to make a maximum contribution to the business. Participation in CTE has expanded rapidly since the process was established in 1985; more than 200 active teams are deployed currently and significant successes are being achieved.

9901 Management

REFER ALSO TO CITATION(S) 40736, 40897, 42891, 42900

42864 (CONF-8706175—1) AI [Artificial Intelligence] tool helps Navy analysts prepare budgets. Emrich, M.L.; Hwang, Ho-Ling. (Oak Ridge National Lab., TN (USA)). 9 Jun 1987. Contract AC05-84OR21400. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011674.

From Expert systems conference; Dearborn, MI, USA (9 Jun 1987).

The application of Artificial Intelligence methodologies, in particular expert systems, to aid in the budget preparation process has been explored. Researchers at Oak Ridge have designed, constructed, and demonstrated a budget preparation system (BUDPREP) for the United States Navy. The BUDPREP system aids Navy budget analysts with the preparation of Base Operating Support (BOS) budget submissions. The BOS budget requires that a large amount of budget data be gathered and detailed on forms. The final proposal represents the estimate of what a field activity will need to support its programs for maintaining buildings, providing utilities, managing waste disposal, etc. Prior to the budget preparation system, the budgeting process was performed manually. This paper describes research efforts being conducted at the Oak Ridge National Laboratory in this area. The budgeting process, the tools used, and the structure of the system are discussed. The knowledge acquisition approaches used in developing the system, insights gained from the development and testing of the system, and plans for future enhancements of the system's capabilities are presented.

42865 (DOE/MA—0299-1) Department of Energy audit resolution, followup and internal control review activity: Quarterly management report as of March 31, 1987. (USDOE Assistant Secretary for Management and Administration, Washington, DC. Audit Liaison Div.). Jul 1987. 53p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87013580.

During the quarter ended March 31, 1987, there were 37 audit reports received with $1.4 million in new questioned costs. There were 32 audit reports closed, and the amounts reinstated and recovered were $1.5 million and $0.5 million. A total of 168 reports remained open and $22.8 million in questioned costs required further action. Thirty-six of the open reports in DARTS with $8.3 million in questioned costs were more than two years old. Six draft and two final GAO reports requiring responses to GAO and/or the Congress were received and an additional 30 final reports were received for information. Thirteen GAO final reports for which a response to the Congress had been prepared by DOE were open in the DARTS. Corrective action remains to be taken on two open GAO reports which were more than two years old. 15 IG reports were issued requiring preparation of a Departmental position. Preparation of Departmental positions on 21 reports were in process. Fifty-eight IG reports which required a Departmental position were open in DARTS. Corrective action remains to be taken on seven open IG reports which were more than two years old. Four material weaknesses were reported to the President in the Secretary's annual assurance letter. An additional 32 material weaknesses were identified in letters to the Secretary from Heads of Departmental elements. These material weaknesses are being tracked in the Departmental Internal Control Tracking System. Four ICRs were completed, increasing the number of completed ICRs to nine. As of March 31, 1987, 30 ICRs remain to be completed, 16 ICRs were in process, and 14 had not started. Four significant recommendations resulting from internal control review reports were closed, leaving seven significant open recommendations in three reports as of March 31, 1987.

9902 Mathematics And Computers

REFER ALSO TO CITATION(S) 42037

42866 (AD-A—180254/5/XAB) Planning under uncertainty using parallel computing. Technical report. Dantzig, G.B. (Stanford Univ., CA (USA). Systems Optimization Lab.). Jan 1987. 23p. (SOL—87-1). NTIS, PC A02/MF A01.

Revision to Rept. No. SOL-86-11, AD-A169-778.

Industry and government routinely solve deterministic mathematical programs for planning and scheduling purposes, some involving thousands of variables with a linear or nonlinear objective and inequality constraints. The solutions obtained are often ignored because they don't properly hedge against future contingencies. It is relatively easy to reformulate models to include uncertainty. The

bottleneck has been (and is) capability to solve them. The time is now ripe for finding a way to do so. To this end, this paper described how large-scale system methods for solving multi-staged systems, such as Bender's Decomposition, high-speed sampling or Monte Carlo simulation, and parallel processors can be combined to solve some important planning problems involving uncertainty. For example, parallel processors may make it possible to come to better grips with the fundamental problems of planning, scheduling, design, and control of complex systems such as the economy, an industrial enterprise, an energy system, a water-resource system, military models for planning and control, decisions about investment, innovation, employment, and health-delivery systems.

42867 **(AD-A—180285/9/XAB) Machine self-teaching methods for parameter optimization. Final report, October 1984-August 1986.** Dillard, R.A. (Naval Ocean Systems Center, San Diego, CA (USA)). Dec 1986. 89p. (NOSC/TR—1039). NTIS, PC A05/MF A01.

The problem of determining near-optimum parameter-control logic is addressed for cases where a sensor or communication system is highly flexible and the logic cannot be determined analytically. A system that supports human-like learning of optimum parameters is outlined. The major subsystems are (1) a simulation system (described for a radar example), (2) a performance monitoring system, (3) the learning system, and (4) the initial knowledge used by all subsystems. The initial knowledge is expressed modularly as specifications (e.g., radar constraints, performance measures, and target characteristics), relationships (among parameters, intermediate measures, and component performance measures), and formulas. The intent of the learning system is to relieve the human from the very tedious trial-and-error process of examining performance, selecting and applying curve-fitting methods, and selecting the next trial set of parameters. A learning system to design a simple radar meeting specific performance constraints is described in detail, for experimental purposes, in generic object-based code.

42868 **(CONF-870294—1) A look at the evolution of mathematical software for dense matrix problems over the past fifteen years.** Dongarra, J.J.; Sorensen, D.C. (Argonne National Lab., IL (USA); Illinois Univ., Urbana (USA). Center for Supercomputing Research and Development). 1987. Contract FG02-85ER25001;W-31109-ENG-38;AC05-84OR21400. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011485.

From International seminar on scientific supercomputers; Paris, France (2 Feb 1987).

This paper looks at the evolution which has taken place in the design of mathematical software for dense matrix problems. Also examined are the problems facing implementation of such algorithms on a large number of processors. The main emphasis is on algorithms for solving linear algebra problems where the software developed would reside in a library on high-performance computers.

42869 **(CONF-870552—19) Multiprocessor data acquisition system.** Haumann, J.R.; Crawford, R.K. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 6p. NTIS, PC A02. File Number DE87011429.

From 5. conference on real-time computer applications in nuclear, particle, and plasma physics; San Francisco, CA, USA (11 May 1987).

A multiprocessor data acquisition system has been built to replace the single processor systems at the Intense Pulsed Neutron Source (IPNS) at Argonne National Laboratory. The multiprocessor system was needed to accommodate the higher data rates at IPNS brought about by improvements in the source and changes in instrument configurations. This paper describes the hardware configuration of the system and the method of task sharing and compares results to the single processor system.

42870 **(CONF-870677—8) Parallel computation of a domain decomposition method.** Chin, R.C.Y.; Hedstrom, G.W.; Scroggs, J.S.; Sorensen, D.C. (Lawrence Livermore National Lab., CA (USA); Illinois Univ., Urbana (USA). Center for Supercomputing Research and Development; Argonne National Lab., IL (USA)). 1987. Contract FG02-85ER25001;W-7405-ENG-48;W-31109-ENG-38. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011444.

From 6. IMACS international symposium on computer methods for partial differential equations; Bethlehem, PA, USA (23 Jun 1987).

The most easily tractable multiple scale problems are those in which there are only a small number of widely separated groups of scales and the motion on the fastest scales has little influence on the smooth part of the solution. An identifying feature of this class is the presence of regions in which the solution undergoes rapid variation. Such regions are called boundary or internal layers, depending on whether they are located near a boundary or in the interior of the domain. These are the problems which are most natural for multitasking because it makes sense to break up the domain according to the regions of different local behavior. This paper restricts its attention to this class of multiple scale problems.

42871 **(CONF-870898—1) Prioritization techniques based on stochastic paired comparisons.** Uppuluri, V.R.R. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011115.

From Joint statistical meeting; San Francisco, CA, USA (16 Aug 1987).

In 1977, Thomas L. Saaty introduced a method of assigning weights to categories based on data on paired comparisons. If we let a/sub ij/ denote the relative importance of the object being classified into the ith category, as opposed to the jth category, then it is assumed that a/sub ij/ = 1/a/sub ij/. The normalized eigenvector associated with the largest eigenvalue of the this reciprocal matrix is suggested as the vector of weights associated with the categories. In this paper, we extend this technique when the data is based on stochastic paired comparisons.

42872 **(CONF-870899—1) A graphical tool for observing the behavior of parallel logic programs.** Disz, T.; Lusk, E. (Illinois Benedictine Coll., Lisle (USA). Dept. of Mathematics and Computer Science; Argonne National Lab., IL (USA)). Mar 1987. Contract W-31109-ENG-38. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011467.

From 4. symposium on logic programming; San Francisco, CA, USA (31 Aug 1987).

A graphical tool is described that has been useful in studying and improving the behavior of parallel logic programs. The parallel logic programming system being studied is ANLWAM, a parallel version of the Warren abstract machine that runs on a variety of shared-memory multiprocessors. The graphical tool, called WAMTRACE, currently runs on Sun workstations. The coupling between the two is not close, and WAMTRACE can easily be interfaced to other parallel systems. We describe here the features of the system, and give several examples of how it can be used to improve one's understanding of both a parallel logic program and the system that provides its parallel execution environment.

42873 **(CONF-8506359—1) Vibrational-feedback control of decentralized systems: A design algorithm.** Runolfsson, T.; Meerkov, S.M. (Michigan Univ., Ann Arbor (USA). Dept. of Electrical Engineering and Computer Science). 1985. Contract FG02-85ER13315. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011172.

From IFAC workshop on model error concepts and compensation; Boston, MA, USA (17 Jun 1985).

A procedure for design of periodic control laws for decentralized, linear, time-invariant systems is given.

42874 (CONF-8605122—5) Vibrational feedback control. Meerkov, S.M. (Michigan Univ., Ann Arbor (USA). Dept. of Electrical Engineering and Computer Science). 1986. Contract FG02-85ER13315. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011173.

From 4. symposium on energy engineering sciences: chemical processes and control - non-linear systems; Argonne, IL, USA (7 May 1986).

This paper illustrates that in addition to closed loop pole placement, vibrational feedback control leads to a possibility of open loop zeros assignability. On this basis, the superior performance characteristics of periodic controllers are explained.

42875 (CONF-8606315—1) Vibrational stabilizability of a class of distributed parameter systems. Bentsman, J.; Meerkov, S.M.; Shu, Xianshu. (Illinois Univ., Urbana (USA). Dept. of Mechanical and Industrial Engineering; Michigan Univ., Ann Arbor (USA). Dept. of Electrical Engineering and Computer Science; Illinois Inst. of Tech., Chicago (USA). Dept. of Electrical and Computer Engineering). 1986. Contract FG02-85ER13315. 3p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011170.

From IFAC symposium on distributed parameter systems; Los Angeles, CA, USA (1 Jun 1986).

A number of experimental and theoretical results reported in the current literature demonstrate stabilization of DPS (distributed parameter systems) by the introduction of zero mean oscillations in their parameters. Stability analysis in each case, however, is based on the specificities of a model under consideration. The present paper introduces a method of stability analysis for a class of DPS and derives a set of conditions of vibrational stabilizability.

42876 (CONF-8706130—2) Frequency-coded artificial neural networks: An approach to self-organizing systems. Dress, W.B. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 9p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87011122.

From 1. IEEE international conference on neural networks; San Diego, CA, USA (21 Jun 1987).

A frequency-based model of an artificial neural network is being explored for active learning in a simulated environment and for its response to multiple modalities of input data. Physical sensors couple naturally to such a network, providing an easy migration path from simulation to application. The combination of an artificial neural network processing frequency-coded sensor information and implemented on advanced computer architectures is seen as an answer to the problems arising in robotics and the fusion of large quantities of multisensory data.

42877 (CONF-8706130—3) Darwinian optimization of synthetic neural systems. Dress, W.B. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87011121.

From 1. IEEE international conference on neural networks; San Diego, CA, USA (21 Jun 1987).

This paper suggests a synthesis of computer science and artificial intelligence with the resurgent ideas of artificial neural systems and genetic algorithms cast in a classical Darwinian mold. Just as Darwin's original theory avoided the need for teleological arguments, the thrust of the approach set forth here for synthetic systems avoids the problem of programmer omniscience and the resulting brittle programs for precisely the same reasons. The price to be paid is one of many long computations on, perhaps, many parallel processors. Hardware development leading to parallel networks of RISC processors should meet the near-term needs of evolutionary parameter determination and allow the ensuring synthetic systems to function in real-time for certain tasks. In the longer term, special-purpose devices will be needed.

42878 (DOE/ER/25026—6) s-step iterative methods for symmetric linear systems. Chronopoulos, A.T.; Gear, C.W. (Illinois Univ., Urbana (USA). Dept. of Computer Science). Jun 1987. Contract FG02-87ER25026. 28p. (UILU-ENG—87-1733; UIUCDCS-R—87-1345). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87010819.

This paper introduces the s-step Conjugate Gradient Method for Symmetric and Positive Definite (SPD) linear systems of equations and discusses its convergence and stability properties. In the s-step Conjugate Gradient method iteration s new directions are formed simultaneously from (r/sub i/, Ar/sub i/, ..., A/sup s-1/r/sub i/) and the preceding s directions. All s directions are chosen to be A-orthogonal to the preceding s directions. The approximation to the solution is then advanced by minimizing an error functional simultaneously in all s directions. This intuitively means that the progress towards the solution in one iteration of the s-step method equals the progress made over s consecutive steps of the one-step method. This is proven to be true.

42879 (EFI—856(7)-86) HBOOK program system. Users manual. Artenyan, A.S.; Badalyan, S.G.; Egikyan, R.S. (Erevanskij Fizicheskij Inst. (USSR)). 1986. 70p. (In Russian). NTIS (US Sales Only), PC A04/MF A01. File Number DE87702703.

The present work is a detailed description being at the same time a manual for users of the HBOOK program system intended for vizualization of results of experimental data statistical analysis carried out by a method of constructing various histograms. The authors made use of available original materials on the HBOOK system, the basic version of which was originated at CERN (Geneva). The authors took also account of their experience acquired when working with this system on the CDC-6500 computer as well as on the ES-1022 and Besm-6 computers. 8 references, 1 table.

42880 (EUR—10629) Multinary systems and reliability models from coherence to some kind of non-coherence. Mazars, N. (Commission of the European Communities, Ispra (Italy). Joint Research Centre; Commission of the European Communities, Luxembourg). 1986. 164p. NTIS (US Sales Only), PC A08/MF A01. File Number DE87752290.

First restricted to models for binary systems, reliability theory is being generalized for multinary systems, of multinary components. After a general viewpoint on reliability models for multinary systems, coherence generalizations are examined. First studied in terms of structure functions, the binary coherent systems can be fully characterized in terms of their minimal path (cut) sets as well as in terms of their life functions. Various fundamental notions such as minimal path (cut) sets and relevance first are introduced in terms of structure functions. The binary decompositions are studied and used for characterizing the broad-sense coherence in terms of sets. The binary-type coherence, the homogenous coherence and the various types of strict-sense coherence are reviewed and fully characterized in various ways. Life functions lead to some model useful for reliability calculations. Methods for determining, in a exact or approximated way, reliability characteristics of multinary coherent systems are studied from both of the fundamental models of reliability, then possible. Futhermore, some kind of non-coherent multinary system is suggested. This analysis may be interesting in the nuclear field.

42881 (JINR—D-10-11-84-818, pp 315-317) **New mathematical methods of experiment planning and their application for identification, modelling and optimization of physical objects using computers.** Solov'ev, G.N.; Chalyj, V.D.; Petrenko, V.V. (Moskovskij Inzhenerno-Fizicheskij Inst., USSR; Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1985. (In Russian). NTIS (US Sales Only), PC A16/MF A01. File Number DE87780164. (CONF-8309402—).

From 5. international meeting on problems of mathematical simulation, programming, and mathematical methods for solving the physical problems; Dubna, USSR (20 Sep 1983).

The problems of determining the order of mathematical models of complex objects adopted in investigations using the experiment planning methods are discussed. The method for construction of models of an arbitrary order based on using the classical and developed plans and the method for synthesizing particular models of objects having 8-20 input variables are considered in brief. Application of the above methods in installations such as a low-energy electron linac, multisection proton and electron linacs, cyclic accelerators, lasers and thermonuclear devices provides determining op-

timal conditions improving the quality of fundamental investigations. The operation stability of the installations is rised 2.5-3.0 times.

42882 (JINR—D-10-11-84-818, pp 350-352) **Method for total automation of many-dimensional diffraction spectra analysis.** Zlokazov, V.B. 1985. (In Russian). NTIS (US Sales Only), PC A16/MF A01. File Number DE87780164. (CONF-8309402—).

From 5. international meeting on problems of mathematical simulation, programming, and mathematical methods for solving the physical problems; Dubna, USSR (20 Sep 1983).

A method meant for automatic analysis of amplitude many-dimensional spectra is described. At the first stage peak search including the procedures of smoothing, identification of peak vertices and their sorting is realized. The method is used in the FIND 2 and DOMUS FORTRAN programs that can operate both on the ES-1040 and CDC-6500 type large computers and SM-3 and SM-4 type small computers. 2 refs.

42883 **(JINR—D-10-11-84-818) Proceedings of 5. International meeting on problems of mathematical simulation, programming, and mathematical method for solving the physical problems. Mathematical simulation.** (Joint Inst. for Nuclear Research, Dubna (USSR)). 1985. 373p. (In Russian). (CONF-8309402—). NTIS (US Sales Only), PC A16/MF A01. File Number DE87780164.

From 5. international meeting on problems of mathematical simulation, programming, and mathematical methods for solving the physical problems; Dubna, USSR (20 Sep 1983).

Seperate abstracts were prepared for 43 papers in these proceedings. (DWL)

42884 **(NIKHEF-K-DIGEL—68) BACON-52. Single board controller.** Waard, J. de. (Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie K). [1987]. 48p. (In Dutch). NTIS (US Sales Only), PC A03/MF A01. File Number DE87702848.

A single board basic computer has been developed and constructed on the basis of the Intel 8052 AH basic chip. The size of the computer board is smaller than an eurocard and can be mounted on the latter piggy-back. 31 figures.

42885 **(ORNL/CSD/TM—254) An evaluation of WPS-Plus word processing software for the IBM PC and compatibles.** Reeves, C.A. Jr.; Turpin, D.M. (Oak Ridge National Lab., TN (USA)). 6 Jun 1987. Contract AC05-84OR21400. 14p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87011972.

An evaluation was performed on WPS-Plus/Workstation PC-based word processing software available from the Digital Equipment Corp. (DEC). This review concentrated on two areas: review of the built-in DEC VT100/220/240 terminal emulation software, and evaluation of the word processing functions themselves, with the former being the primary point of emphasis. The software was found in general to compare favorably with similar software residing in the DEC VAX computers, and files generated with WPS-Plus/Workstation can be transferred to the VAX computers and edited with WPS-Plus in the VAX and vice-versa, with all formatting codes intact. However, many functions most users have grown to expect in word processing software are lacking in WPS-Plus/Workstation. Thus the product can only be recommended for those who use WPS-Plus on the VAX and desire the same user interface and functionality in a personel computer product.

42886 **(ORNL/M—362) Holifield Heavy Ion Research Facility computer handbook, 1987.** (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 346p. NTIS, PC A15/MF A01; 1; GPO Dep. File Number DE87011928.

This document is intended to acquaint a prospective user with the Holifield Heavy Ion Research Facility (HHIRF) data acquisition/analysis computer facility. The HHIRF data acquisition/analysis computer facility is comprised of 3 CONCURRENT 3230 computers and peripherals. These are 32-bit word machines, each 16 megabytes of semiconductor memory. Peripherals on each system include: three or more disk drives, 2 or 3 TELEX (1600/6450 bpi) tape drives, a line printer, several CPU-shared TRILOG printer/plotters, a CPU-shared TEK-4696 color Ink-Jet plotter, several graphics terminals, a number of VDT terminals and CAMAC interfaces.

42887 **(ORNL/TM—10452) The evolution of the minimum degree ordering algorithm.** George, A.; Liu, J.W.H. (Oak Ridge National Lab., TN (USA)). May 1987. Contract AC05-84OR21400. 26p. NTIS, PC A03/MF A01; GPO Dep. File Number DE87011705.

Over the past fifteen years, the implementation of the minimum degree algorithm has received much study, and many important enhancements have been made to it. In this article, we describe these various enhancements, trace their historical development, and provide some experiments showing how very effective they are in improving the execution time of the algorithm. We also present a shortcoming that exists in all of the widely used implementations of the algorithm, namely, that the quality of the ordering provided by the implementations is surprisingly sensitive to the initial ordering. For example, changing the input ordering can lead to an increase (or decrease) of as much as a factor of three in the cost of the subsequent numerical factorization. This sensitivity is caused by the lack of an effective tie-breaking strategy, and our experiments illustrate the importance of developing such a strategy.

42888 **(PNL-SA—14590) EXPLOR4: A program for exploring four-dimensional data using stereo-ray glyphs, dimensional constraints, rotation and masking.** Carr, D.B.; Nicholson, W.L. (Pacific Northwest Lab., Richland, WA (USA)). Apr 1987. Contract AC06-76RL01830. 8p. (CONF-8703131—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011989.

From 19. symposium on the interface of computer science and statistics; Philadelphia, PA, USA (8 Mar 1987).

This paper presents an approach to the visual exploration of four-dimensional data based on the representation of each data point using a single symbol, the stereo-ray glyph. The result is a three-dimensional scatterplot with ray angle showing the fourth coordinate. With this representation and tools for changing the view, local lower dimensionality and density anomalies can be identified. The tools have been integrated in a computer program called EXPLOR4. The tools include tracker-ball controlled three-dimensional rotation in a selected subspace and real-time mouse-controlled point masking. Masking criteria include point density, distance from a hyperplane and distance for a point. Point and subspace constraints required for the operations are provided through interactive graphical specification of four-dimensional point sets.

42889 **(SAND—87-1523) AFTER: Batch jobs on the Apollo ring.** Hofstadler, P. (Sandia National Labs., Albuquerque, NM (USA)). Jul 1987. Contract AC04-76DP00789. 25p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87012326.

This document describes AFTER, a system that allows users of an Apollo ring to submit batch jobs to run without leaving themselves logged in to the ring. Jobs may be submitted to run at a later time or on a different node. Results from the batch job are mailed to the user through some designated mail system. AFTER features an understandable user interface, good on line help, and site customization. This manual serves primarily as a user's guide to AFTER although administration and installation are covered for completeness.

42890 **(SOL—87-6) The box method for linear programming: Part 1, Basic theory.** Zikan, K.; Cottle, R.W. (Stanford Univ., CA (USA). Systems Optimization Lab.). Jun 1987. Contract FG03-87ER25028. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011029.

This paper presents a new interior-point algorithm for linear programming where the constraints are all expressed as inequalities. Along with the concept of "minimum-weight basis", the algorithm features a novel mechanism for finding search directions. Unlike other interior-point methods which implicitly or explicitly involve optimization over ellipsoids for their direction-finding schemes, the

one reported here uses "boxes". The corresponding subproblems are simple linear programs having closed form solutions. It is shown that the iterates generated by the algorithm converge to an extreme point of the feasible region. When this point is nondegenerate, it is optimal and reached within finitely any steps. The methodology introduced here also gives rise to a polyhedral subdivision of the problem's feasible region and in fact to the entire space of decision variables.

42891 **(UCID—21011-Vol.5) Acceptance test plan for DOEDEF [Department of Energy Data Exchange Format] Translator Module Pool A.** Wimple, C. (Lawrence Livermore National Lab., CA (USA)). 14 Apr 1987. Contract W-7405-ENG-48. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011902.

The Department of Energy Data Exchange Format (DOEDEF) Translator Module Pool A (hereafter referred to as the "pool") is intented to reduce the manpower required to rewrite the DOEDEF translator software already in existence throughout the Department of Energy Nuclear Weapons Complex (DOE NWC). Each portion of the DOEDEF exchange system and therefore each site's DOEDEF translator software must be rewritten during the transition from Phase 1.0 to Phase 1.5 of DOEDEF. By providing a pool, some of which (if not all) can be used by multiple NWC sites, the effort required to move from Phase 1.0 to Phase 1.5 can be reduced.

42892 **(UCRL—96186) IDA: An integrated data acquisition system for setup, checkout, capture and analysis of nuclear test program imaging and digital data.** Lennon, W.J. (Lawrence Livermore National Lab., CA (USA)). 11 May 1987. Contract W-7405-ENG-48. 21p. (CONF-870552—20). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011545.

From 5. conference on real-time computer applications in nuclear, particle, and plasma physics; San Francisco, CA, USA (11 May 1987).

A network of CAMAC crates with imbedded micro-processors uses ROM'd code to reliably capture data. Downloaded diagnostic codes provide the needed flexibility to set up, check out and maintain each unique application. A menu driven touch panel user interface minimizes the need for operator training. This allows for field operators to reliably acquire data from downhole nuclear testing.

42893 **(UCRL—96836) UNIX on CTSS.** Lubkin, D. (Lawrence Livermore National Lab., CA (USA)). Jun 1987. Contract W-7405-ENG-48. 9p. (CONF-8704165—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011563.

From Cray User Group spring meeting; New York City, NY, USA (21 Apr 1987).

Through the CTSS-UNIX project, Cray users can have both UNIX System V compatibility and the greater performance and stability of CTSS on all models of Cray and SCS computers.

42894 (ZfI—64, pp 21-22) **UE7 - computation of the time-resolved ESR signal based on extended bloch equations including chemical reaction kinetics.** Hirsch, K. Dec 1986. NTIS (US Sales Only), PC A03/MF A01. File Number DE87702867.

In Computer codes for problems of isotope and radiation research.

42895 **Particle modeling of plasmas on supercomputers.** Dawson, J.M.; Decyk, V.K.; McNamara, B. (Univ. of California, Los Angeles, Los Angeles, CA 90024). *International Journal of Supercomputer Application;* **1**: No. 1, 24-43(1987).

Particle simulation of plasmas (ionized gases) has become a powerful tool for investigating the physics of this complex state of matter, such as normal modes of nonuniform plasmas, and nonlinear behavior. Whereas much of this complex behavior is difficult to measure experimentally, computer modeling can provide detailed information to augment our understanding of physical phenomena. The authors describe the basic methods of particle simulation and present a number of examples that highlight applications of this approach to plasma physics.

42896 **High-speed histogram calculations for real time image processing.** Tucker, S.; Fronek, D.K. (Sandia National Labs., Albuquerque, NM). pp 1-5 of Proceedings of IEEE Southeastcon 87 conference. Piscataway, NJ; IEEE Service Center (1987). (CONF-870478—).

From Southeastcon '87; Tampa, FL, USA (5 Apr 1987).

Providing a historian for a real time image yields significant data concerning segmentation. Hardware realization of the histogram function is possible using high speed RAM and incremental counters. Incoming pixel data addresses a particular memory location to be incremented. Memory data is fetched and incremented while the original pixel maintains the same RAM memory address. For many applications, requiring global and regional thresholding, histogram calculations must be done very quickly. This paper describes a hardware approach that takes the place of intensive software calculations and runs in real time as defined by a 512 x 512 pixel image running at commercial raster rates. The circuit supplies histogram data and maximum/minimum pixel information that can be used in several formats - line, region, or for global images.

9903 Information Handling

REFER ALSO TO CITATION(S) 40402, 42808

42897 **(BNL-NCS—39952) Bibliography and database of isotopic composition data and their variation in nature.** Holden, N.E. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 10p. (CONF-8708105—1). NTIS, PC A02. File Number DE87012865.

From 34. IUPAC General Assembly; Boston, MA, USA (21 Aug 1987).

For the past twenty years, I have collected data on isotopic abundance measurements for the chemical elements and their variation in nature. A preliminary data file of both references and numerical information for complete isotopic abundance data and isotope ratios was originally produced at General Electric in the late 1960s and early 1970s. In 1974, this data file was transferred to Brookhaven. I am now considering the preparation of a random access numerical and bibliographic database of isotopic abundance information.

42898 **(DOE/IG—0242) Selected management issues involving the Energy Information Administration Computer Center.** (USDOE Office of Inspector General, Washington, DC). 27 Jul 1987. 18p. OSTI, PO Bx 62, Oak Ridge, TN 37831. File Number TI87013569.

Report to The Secretary.

The focus of the review was on the Energy Information Administration Computer Center's future plans for equipment acquisitions and the Center's procedures for recording costs and billing users. Our analysis of present computer capacity and projected user demand showed that the Center needs to ensure it is fully using existing capabilities before it makes further equipment purchases. Improvements are also needed in the Center's cost allocation and billing procedures.

42899 **(FEI—1715) Information retrieval automation in the computerized library of thermal-physical data.** Sal'nikova, O.V.; Blokhin, A.I.; Sudnitsyna, M.O. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1985. 19p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702714.

The structure of the thermal-physical data storage and processing automation system (ASKhOD) and its subsystems BIDFID (library of thermal-physical data) and KATALOG is described. Possible variants of user's request are developed. The retrieval program complex carrying out data fetching from BIDFID according to user's requests is developed and reduced to practice. The results of the given paper can be the base for carrying out works in experimental thermal-physical data processing. 6 references, 8 figures.

42900 **(K/CSD/TM—64-Rev.1) Automated Estimating System (AES): Version 2.0, user's manual: Phase 2.** Holder, D.A.; Schwarz, R.L. (ed.). (Oak Ridge Gaseous Diffusion Plant, TN (USA)). Jun 1987. Contract AC05-84OT21400. 160p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE87011916.

This document describes Version 2.0 of the Automated Estimating System, a personal computer-based software package designed to aid in the creation, updating, and reporting of project cost estimates for the Estimating and Scheduling Department of the Martin Marietta Energy Systems Engineering Division.

42901 **(LA-UR—87-1408) Understanding user attitudes: The cornerstone of computer documentation.** Hurford, J.M.; Ramsey, C.A. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 8p. (CONF-8706129—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE87009009.

From Technical Writers Institute meeting; Troy, NY, USA (9 Jun 1987).

Understanding user attitudes is key to the design, development, and production of online and printed computer documentation. User needs for documentation can be addressed best by classifying users according to the attitudes they bring to computing, rather than by their computing knowledge or skill level only. Attitudes are reflected in all types of computer users including scientists, engineers, programmers, administrative assistants, and managers. Attitudes are independent of computing skill level and frequency of use; they apply equally to new users, casual users, or expert users. Identified are three user attitudes at Los Alamos: no-time-to-learn attitude - users simply want to get the job done and have no time to learn about the topic; want-to-learn attitude - users want to learn everything about a topic; know-what-I-want attitude - users are already familiar with similar computing topics and know what information they need.

42902 **(UCRL—92506) The Intelligent Gateway Computer: Effective access to distributed information resources.** Burton, H.D. (Lawrence Livermore National Lab., CA (USA)). Apr 1985. Contract W-7405-ENG-48. 8p. (CONF-8506361—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE87008750.

From 7. International Association of Agriculture Librarians and Documentalists World Congress; Ottawa, Canada (2 Jun 1985).

The Intelligent Gateway Computer, developed by the Lawrence Livermore National Laboratory's Technology Information System, provides ready access to geographically distributed and physically unlike computer-based information resources. Through the Gateway, a user can utilize the variety of resources - such as Lockheed Dialog, ESA-IRS, DARC, and others - without having to learn different access methods and log-ons, and communication protocols. From a single entry point, that subset of textual, numeric, and graphics systems which best meet his needs can be targeted by the Gateway. Retrieval results can be downloaded to a local file and analyzed and reformatted using a number of bibliographic post-processing, mathematical, and statistical routines. For a field such as agriculture, with its wide breadth of subject disciplines and dependence on numerous, disparate information sources, use of a Gateway can greatly facilitate research.

42903 **(UCRL—95039) New telecommunication and database technologies in transborder data flow: An overview for the information community.** Bollinger, W.A.; Fisher, H.L. (Lawrence Livermore National Lab., CA (USA)). Jul 1986. Contract W-7405-ENG-48. 11p. (CONF-861293—1). NTIS, PC A02. File Number DE87011880.

From 10. international online information meeting; London, UK (2 Dec 1986).

Recent advances in telecommunications design and storage/retrieval technologies continue to demonstrate that the potential change in the volume and scope of the international transfer of scientific and technical information is quite substantial. So also the need for the information community to aid in making enlightened decisions in this area. Whether as a group addressing proposed regulatory measures, or individually, by selecting the most efficient of search methods and tools, this requires their keeping well abreast of current trends and developments within the field. In this paper we will present and discuss recent advances as they relate to TDF, grouping and addressing what we find into three broad areas of application: Regulated Networks, concentrating on the potential of integrated services digital networks (ISDN); Shared Systems, detailing programs and commercial systems such as intelligent gateways, teleconferencing networks, and electronic mail systems as used by groups of online searchers for international team research; and Personalized Access Aids, or developments in expert systems and applications for future artificial intelligence programs.

9904 Law

42904 **(IAEA-TECDOC—382) Nuclear development for peaceful purposes: legal and regulatory aspects. Lectures and reports presented at the regional course on legislation and regulation of nuclear safety for Latin American countries, Montevideo, Uruguay, 15-20 October 1984.** (International Atomic Energy Agency, Vienna (Austria)). Oct 1986. 356p. (In Spanish). (CONF-8410472—). NTIS (US Sales Only), PC A16/MF A01. File Number DE87702732.

From Regional course on legislation and regulation of nuclear safety for Latin American countries; Montevideo, Uruguay (15 Oct 1984).

This document contains the 17 lectures and reports presented at the regional course on legislation and regulation of nuclear safety for Latin American countries organized by the IAEA on 15-20 October 1984 in Montevideo, Uruguay. A separate abstract was prepared for each of these papers. Also reproduced are some legal documents related to the subject. Refs, figs and tabs.

42905 (IAEA-TECDOC—382, pp 7-34) **Legal framework for the regulation and control of radiological safety and nuclear installations.** Havinh Phuong. (International Atomic Energy Agency, Vienna, Austria. Legal Div.). Oct 1986. (In Spanish). NTIS (US Sales Only), PC A16/MF A01. File Number DE87702732. (CONF-8410472—).

From Regional course on legislation and regulation of nuclear safety for Latin American countries; Montevideo, Uruguay (15 Oct 1984).

The author presents a systematic survey of the legal and institutional aspects of the development and control of the peaceful uses of nuclear energy, especially the main components of nuclear legislation and implementing regulations in various topical areas. The structure and responsibilities of a licensing authority are outlined, and the IAEA NUSS Programme is described. Nuclear third party liability and the physical protection of nuclear material are discussed in the light of existing international conventions.

42906 (IAEA-TECDOC—382, pp 67-79) **Institutional and regulatory aspects of nuclear activities in Argentina.** Martinez-Favini, J. (Comision Nacional de Energia Atomica, Buenos Aires, Argentina). Oct 1986. (In Spanish). NTIS (US Sales Only), PC A16/MF A01. File Number DE87702732. (CONF-8410472—).

From Regional course on legislation and regulation of nuclear safety for Latin American countries; Montevideo, Uruguay (15 Oct 1984).

This report deals briefly with the history of legal activities connected with nuclear power development in Argentina. The first part deals with the establishment of the Argentine nuclear regulatory and licensing body and the goals of the Argentine nuclear policy. The second part analyses the main legal and regulatory issues involved in nuclear safety and the licensing of nuclear power plants. The third part describes the current Argentine nuclear cooperation agreements.

42907 (IAEA-TECDOC—382, pp 81-88) **Organizational aspects of nuclear activities in Brazil.** Jansen-Laborne, J. (Comissao Nacional de Energia Nuclear de Brasil, Rio de Janeiro). Oct 1986. (In Spanish). NTIS (US Sales Only), PC A16/MF A01. File Number DE87702732. (CONF-8410472—).

From Regional course on legislation and regulation of nuclear safety for Latin American countries; Montevideo, Uruguay (15 Oct 1984).

The lecture provides outlines of the institutional aspects of nuclear development in Brazil and its basic characteristics as background for presentation of the governmental nuclear organization. 1 fig.

42908 (IAEA-TECDOC—382, pp 89-113) **Institutional aspects on the development of nuclear activities in Mexico.** Iturbe, F. (Instituto Nacional de Investigaciones Nucleares, Mexico City). Oct 1986. (In Spanish). NTIS (US Sales Only), PC A16/MF A01. File Number DE87702732. (CONF-8410472—).

From Regional course on legislation and regulation of nuclear safety for Latin American countries; Montevideo, Uruguay (15 Oct 1984).

The lecture describes the institutional development of nuclear energy in Mexico. The goals of the national nuclear policy are outlined, and the organizations involved in the implementation of such policy are mentioned and their structure explained. 11 refs, 3 figs.

42909 (IAEA-TECDOC—382, pp 133-146) **Nuclear standardization in Brazil.** Jansen-Laborne, J. (Comissao Nacional de Energia Nuclear de Brasil, Rio de Janeiro). Oct 1986. (In Spanish). NTIS (US Sales Only), PC A16/MF A01. File Number DE87702732. (CONF-8410472—).

From Regional course on legislation and regulation of nuclear safety for Latin American countries; Montevideo, Uruguay (15 Oct 1984).

The basic considerations governing nuclear standardization in Brazil are presented as well as the system of standardization made up through cooperation between different organizations to harmonize and ensure efficient implementation. 7 figs.

42910 (IAEA-TECDOC—382, pp 147-159) **Organization and functions of the National Commission for Nuclear Safety and Safeguards of Mexico.** Iturbe, F. (Instituto Nacional de Investigaciones Nucleares, Mexico City). Oct 1986. (In Spanish). NTIS (US Sales Only), PC A16/MF A01. File Number DE87702732. (CONF-8410472—).

From Regional course on legislation and regulation of nuclear safety for Latin American countries; Montevideo, Uruguay (15 Oct 1984).

The paper analyses the regulation of nuclear activities in relation to the goals of the Mexican nuclear programme. The governmental organization related to the safety and licensing of nuclear power plants is also presented. 7 refs, 5 figs.

42911 (IAEA-TECDOC—382, pp 161-176) **Chilean Nuclear Safety Act and related legislation.** Frangini-Norris, L. (Comision Chilena de Energia Nuclear, Santiago). Oct 1986. (In Spanish). NTIS (US Sales Only), PC A16/MF A01. File Number DE87702732. (CONF-8410472—).

From Regional course on legislation and regulation of nuclear safety for Latin American countries; Montevideo, Uruguay (15 Oct 1984).

An analysis of the Nuclear Safety Act is presented. The influence of international conventions and regulations on the content of the Act is mentioned. Related legislation on the physical protection and transport of nuclear materials is under preparation.

42912 (IAEA-TECDOC—382, pp 177-185) **Institutional and regulatory aspects of nuclear activities in Uruguay.** Perez-Pineyrua, D. (Comision Nacional de Energia Atomica, Montevideo, Uruguay). Oct 1986. (In Spanish). NTIS (US Sales Only), PC A16/MF A01. File Number DE87702732. (CONF-8410472—).

From Regional course on legislation and regulation of nuclear safety for Latin American countries; Montevideo, Uruguay (15 Oct 1984).

The author presents a comprehensive survey of nuclear legislation in Uruguay. National nuclear development is described within the historical and political context.

CORPORATE AUTHOR INDEX

In the Corporate Author Index, report literature is indexed using the name of the organization or institution responsible for issuing the report. Headings are provided for all report literature and for published literature for which a corporate approach is especially desirable, e.g., symposium and conference proceedings.

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The notations in the final parentheses indicate the type of document, e.g., R for Report; the country of publication, e.g., US; and the language if other than English, e.g., In German. Tables of document types and country of publication codes appear after the indexes.

The title may be supplemented with additional words, or a phrase, if it appears additional information would be helpful. In cases for which the title contains little or no information related to the subject entry, it may be replaced entirely by the supplementary information. A qualifier is not always required, and in such cases the title will follow the unqualified subject descriptor.

The descriptors selected for use as subject terms are generally the names of specific materials, things, or processes. To the extent possible, a qualifier is selected to describe the properties of, or processes applied to, the subject term.

Index entries are selected to indicate the important ideas and concepts presented in a document, rather than words that may appear in the text. Within the available thesaurus terms, the most probable or logical place to look for typical information is selected. "See references" are included to guide users from synonymous terms or phrases to the descriptor selected as a subject heading for the concept (e.g., Pipeline Quality Gas, see HIGH BTU GAS). "See also references" are used to indicate where to find references to subject concepts that are narrower, broader, or related to a particular subject heading. To complete an exhaustive search of a given subject, all such headings should be reviewed. Copies of DOE/TIC-7000, the Subject Thesaurus, are available from the National Technical Information Service (NTIS), U.S. Department of Commerce, Springfield, VA 22161.

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AC05-84OT21400	**Oak Ridge Gaseous Diffusion Plant, TN (USA)**	
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AC05-86OR21600	**Westinghouse Materials Co. of Ohio, Cincinnati (USA). Feed Materials Production Center**	
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AC06-76RL01830	**Pacific Northwest Lab., Richland, WA (USA)**	
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AC06-76RL01857	**UNC Nuclear Industries, Inc., Richland, WA (USA)**	
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AC06-77RL01030	**Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations**	
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AC07-76ID01570	**Pacific Northwest Lab., Richland, WA (USA)**	
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AC08-84NV10322	**Fenix and Scisson, Inc., Mercury, NV (USA)**	
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AC09-76SR00001	**Savannah River Lab., Aiken, SC (USA)**	
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	Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant	
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AC11-76PN00014	Bettis Atomic Power Lab., West Mifflin, PA (USA)	
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AC12-76SN00052	Knolls Atomic Power Lab., Schenectady, NY (USA)	
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AC19-80BC10313	Gulf Research & Development Co., Pittsburgh, PA	
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AC21-84MC21225	Institute of Gas Technology, Chicago, IL (USA)	
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AC21-84MC21313	Institute of Gas Technology, Chicago, IL (USA)	
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AC21-85FC10627	Pennsylvania State Univ., University Park (USA). Coll. of Earth and Mineral Sciences	
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AC21-85MC21353	EG and G/Washington Analytical Services Center, Inc., Morgantown, WV (USA)	
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AC21-85MC22058	Avco-Everett Research Lab., Everett, MA (USA)	
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AC22-83PC62690	BCR National Lab., Monroeville, PA (USA)	
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AC22-83PC63046	Lehigh Univ., Bethlehem, PA (USA)	
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AC22-86PC90751	Physical Sciences, Inc., Andover, MA (USA)	
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AC79-85BP20933	Mater Engineering Ltd., Corvallis, OR (USA)	
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AI01-76ET20320	National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center	
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AI21-80ET17088	ECO Energy Conversion, Somerville, MA (USA)	
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AP79-86BP31011	Tacoma Office of Intergovernmental Affairs/ Energy, WA (USA)	
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AS07-86ID12626	Wisconsin Univ., Madison (USA)	
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AT01-79ER10497	National Bureau of Standards, Washington, DC (USA). Thermophysics Div.	
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FC21-83FE60177	Western Research Inst., Laramie, WY (USA)	
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FG01-86CE63490	Amador-Tuolumne Community Action Agency, Jackson, CA (USA)	
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FG02-84ER45112	Cornell Univ., Ithaca, NY (USA). Sibley School of Mechanical and Aerospace Engineering	
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FG02-84ER45116	Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Materials Science and Engineering	
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FG02-84ER45161	Pennsylvania Univ., Philadelphia (USA). Dept. of Materials Science	
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FG02-85ER13315	Illinois Univ., Urbana (USA). Dept. of Mechanical and Industrial Engineering	
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	Michigan Univ., Ann Arbor (USA). Dept. of Electrical Engineering and Computer Science	
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	Illinois Univ., Urbana (USA). Dept. of Mechanical and Industrial Engineering	
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FG02-85ER13405	State Univ. of New York, Stony Brook (USA). Research Foundation	
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FG02-85ER13449	Brigham Young Univ., Provo, UT (USA). Dept. of Physics and Astronomy	
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	Brigham Young Univ., Provo, UT (USA)	
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FG02-85ER25001	Argonne National Lab., IL (USA)	
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	Lawrence Livermore National Lab., CA (USA)	
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FG02-85ER40233	Northeastern Univ., Boston, MA (USA)	
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FG02-85ER45224	Michigan Technological Univ., Houghton (USA). Dept. of Physics	
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FG02-85ER53212	**Wisconsin Univ., Madison (USA)**	
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FG02-86ER13463	**Brigham Young Univ., Provo, UT**	
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FG02-86ER13579	**Minnesota Univ., Minneapolis (USA). Dept. of Chemistry**	
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FG02-86ER40286	**Iowa Univ., Iowa City (USA). Dept. of Physics and Astronomy**	
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FG02-86ER45271	**E.I. du Pont de Nemours & Co., Inc., Wilmington, DE**	
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FG02-87ER25026	**Illinois Univ., Urbana (USA). Dept. of Computer Science**	
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FG02-87ER40315	**Carnegie-Mellon Univ., Pittsburgh, PA (USA)**	
	12:42510	DOE/ER/40315—142
FG02-87ER45297	**Arizona Univ., Tucson (USA)**	
	12:41295	DOE/ER/45297—3
FG02-87ER60515	**Michigan Univ., Ann Arbor (USA). Dept. of Biology**	
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	Michigan State Univ., East Lansing (USA). Dept. of Botany and Plant Pathology	
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	Michigan State Univ., East Lansing (USA). Dept. of Zoology	
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FG03-85ER45207	**Cincinnati Univ., OH (USA). Dept. of Chemistry**	
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FG03-86ER52123	**California Univ., Los Angeles; Argonne National Lab., IL; Westinghouse Hanford Co., Richland, WA**	
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FG04-84ER45099	**Univ. of New Mexico, Albuquerque**	
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FG05-84ER13292	**Univ. of Texas, El Paso**	
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FG05-85ER13413	**Texas Univ., Arlington (USA). Dept. of Geology**	
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FG05-85ER13434	**Texas A & M Univ., College Station**	
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FG05-85ER40226	**Vanderbilt Univ., Nashville, TN (USA)**	
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FG05-86ER13575	**Florida State Univ., Tallahassee (USA)**	
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FG05-86ER13626	**Texas Univ., Austin (USA)**	
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FG05-86ER45259	**North Carolina State Univ., Raleigh**	
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FG06-86ER25019	**Washington Univ., Seattle (USA). Dept. of Applied Mathematics**	
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FG07-84ID12526	**Oregon State Dept. of Geology and Mineral Industries, Portland (USA)**	
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FG22-84PC70006	**Colorado School of Mines, Golden (USA). Dept. of Chemical Engineering and Petroleum Refining**	
	12:40331	DOE/PC/70006—T8
FG22-84PC70764	**Ohio State Univ., Columbus (USA). Dept. of Mechanical Engineering**	
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FG22-84PC70801	**Illinois Univ., Urbana (USA). Dept. of Chemical Engineering**	
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FG22-84PC70808	**Univ. of Pittsburgh, PA**	
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FG22-85PC80507	**Colorado Univ., Boulder (USA)**	
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FG22-85PC80752	**Brigham Young Univ., Provo, UT (USA). Combustion Lab.**	
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FG22-85PC80907	**Colorado School of Mines, Golden (USA). Dept. of Chemical Engineering and Petroleum Refining**	
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FG22-86PC90518	**Princeton Univ., NJ (USA). Dept. of Chemical Engineering**	
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FG22-86PC90912	**Rockwell International Corp., Thousand Oaks, CA (USA). Science Center**	
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FG22-86PC90913	**Atlantic Research Corp., Alexandria, VA (USA)**	
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FG22-86PC90959	**California Inst. of Tech., Pasadena (USA)**	
	12:41838	DOE/PC/90959—T2
FG22-86PC90962	**Southwest Research Inst., San Antonio, TX (USA)**	
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8729	NTIS (US Sales Only), PC A02/MF A01	DE87752254	MN -37	12:41789
8740	NTIS (US Sales Only), PC A02/MF A01	DE87752261	MN -48	12:42061
8743	NTIS (US Sales Only), PC A02; 3	DE87751633	MN -28	12:41685
8750	NTIS (US Sales Only), PC A02/MF A01	DE87752255	MN -48	12:42062
8751	NTIS (US Sales Only), PC A02/MF A01	DE87752256	MN -48	12:42063
8781	NTIS (US Sales Only), PC A02/MF A01	DE87752252	MN -37	12:41836
8813	NTIS (US Sales Only), PC A02/MF A01	DE87752283	MN -78	12:40966
8816	NTIS (US Sales Only), PC A02/MF A01	DE87752282	MN -78	12:40967
8817	NTIS (US Sales Only), PC A02/MF A01; 1	DE87752532	MN -11	12:42293
CEA-DAS-				
284	NTIS (US Sales Only), PC A07; 3	DE87752534	MN -11	12:42294
285	*See* CEA-CONF-8816	DE87752282	MN -78	12:40967
286	*See* CEA-CONF-8813	DE87752283	MN -78	12:40966
CEA-DPh-G-LLB-SDN-				
86-45	*See* CEA-CONF-8729	DE87752254	MN -37	12:41789
CEA-IPSN-INFO-				
47	NTIS (US Sales Only), PC A02/MF A01	DE87752277	MN -80	12:40968
49-Rev.1	NTIS (US Sales Only), PC A02/MF A01	DE87752278	MN -78	12:40969
54	NTIS (US Sales Only), PC A02/MF A01	DE87752276	MN -79	12:40872
58	NTIS (US Sales Only), PC A02/MF A01	DE87752275	MN -80	12:41554
CEA-R-				
5367	NTIS (US Sales Only), PC A04/MF A01	DE87752248	MN -11	12:41971
CEA-SPhT-				
86-003	*See* CEA-CONF-8341	DE87752260	MN -34D	12:42444
86-021	*See* CEA-CONF-8337	DE87752259	MN -34	12:42638
CEBAF-PR-				
86-005	*See* DOE/ER/40150-11	DE87008660	MN -28	12:41687
86-010	*See* DOE/ER/40150-14	DE87008661	MN -28	12:41688
87-001	*See* DOE/ER/40150-21	E 1.99: DE87008669	MN -28	12:41689
87-005	*See* DOE/ER/40150-20	DE87008663	MN -28	12:41740
87-022	*See* DOE/ER/40150-4	E 1.99: DE87012469	MN -34D	12:42446
CERN-				
87-01	NTIS (US Sales Only), PC A18/MF A01	DE87702667	MN -51	12:41683
CERN-HERA-				
87-01	NTIS (US Sales Only), PC A06/MF A01	DE87702668	MN -34D	12:42416
CESAR-				
87/ 08	*See* ORNL/TM-10397	E 1.99: DE87011950	MN -38	12:41599
87/ 21	*See* CONF-870679-2	E 1.99: DE87010893	MN -38	12:41586
CNA-PP-				
451	*See* AD-A-180337/8/XAB			12:41864
COAL-				
8518	*See* PB-87-190906/XAB			12:40356
8601	*See* PB-87-190948/XAB			12:40396
CONF-8309402-	(5. international meeting on problems of mathematical simulation, programming, and mathematical methods for solving the physical problems, Dubna, USSR, 20-23 Sep 1983)			
	See JINR-D-10-11-84-818	DE87780164	MN -32	12:42883
CONF-8312151-	(Seminar on strategies of energy supply for third world countries, Berlin, F.R. Germany, 5-9 Dec 1983)			
Summs.	NTIS (US Sales Only), PC A06; 3	DE87770181	MN -98	12:41089

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CONF-840873-	(US summer school on high energy particle accelerators, Batavia, IL, USA, 13-24 Aug 1984)			
7	*See* SLAC-PUB-4169	DE87005577	MN -28	12:41722
CONF-8410472-	(Regional course on legislation and regulation of nuclear safety for Latin American countries, Montevideo, Uruguay, 15-20 Oct 1984)			
	See IAEA-TECDOC-382	DE87702732	MN -2	12:42904
CONF-8501109-	(3. CSIC workshop on SUSY and grand unification from strings to collider phenomenology, Madrid, Spain, 30 Jan-2 Feb 1985)			
1	*See* CEA-CONF-8341	DE87752260	MN -34D	12:42444
CONF-8502156-	(Discussion meeting on measuring processes with opto-electronic semiconductor components, Lahnstein, F.R. Germany, 6-7 Feb 1985)			
	See INIS-mf-10636		ND -37	12:41839
CONF-8506237-	(Photovoltaics and insolation measurements workshop, Vail, CO, USA, 30 Jun-3 Jul 1985)			
	Sol. Cells, 18: No. 3/4, 251-260(Sep-Oct 1986)			12:40717
CONF-8506359-	(IFAC workshop on model error concepts and compensation, Boston, MA, USA, 17-18 Jun 1985)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011172	MN -32	12:42873
CONF-8506361-	(7. International Association of Agriculture Librarians and Documentalists World Congress, Ottawa, Canada, 2-6 Jun 1985)			
1	*See* UCRL-92506	E 1.99: DE87008750	MN -32	12:42902
CONF-850771-	(SLAC summer school on the physics of high energy particle accelerators, Stanford, CA, USA, 15-26 Jul 1985)			
11	*See* BNL-39684	DE87010046	MN -28	12:41735
12	*See* SLAC-PUB-4103	E 1.99: DE87008318	MN -28	12:41721
CONF-850834-	(WINDPOWER '85, San Francisco, CA, USA, 27-30 Aug 1985)			
9	NTIS (US Sales Only), PC A02/MF A01; 1	DE87770184	MN -60	12:40743
CONF-850840-	(Joint meeting of the Electron Microscopy Society of America and the Microbeam Analysis Society, Louisville, KY, USA, 5-9 Aug 1985)			
20	*See* HEDL-SA-3351	TI87010420	ND -25	12:41280
CONF-850933-	(13. international conference on solid state nuclear track detectors, Rome, Italy, 23-27 Sep 1985)			
12	*See* HEDL-SA-3317	DE87010724	MN -78	12:40857
CONF-8509317-	(SMM topical workshop on rapid fluctuations in solar flares, Lanham, MD, USA, 30 Sep-4 Oct 1985)			
	See N-87-21785			12:42319
CONF-8509387-	(12. summer school on quantum optics, Frombork, Poland, 2-8 Sep 1985)			
2	*See* CEA-CONF-8328	DE87752257	MN -34A	12:42349
CONF-8509389-	(Final conference on scientific-technological cooperation between the MoH of the USSR and the SAAS of the GDR, Tashkent, USSR, 2-7 Sep 1985)			
Pt.2	*See* SAAS-342	DE87780154	MN -11	12:41681
CONF-8509403-	(8. national congress on applied and computational mathematics, Florianopolis, Brazil, 16-20 Sep 1985)			
1	*See* INIS-BR-649	DE87702758	MN -20	12:42730
2	*See* INIS-BR-650	DE87702759	MN -80	12:40904
CONF-851011-	(4. symposium on separation science and technology for energy applications, Knoxville, TN, USA, 20-24 Oct 1985)			
	See Sci. Technol., 22: No. 2/3, 745-762(1987)			12:40397
	See Sci. Technol., 22: No. 2/3, 889-910(1987)			12:40472
	New York, NY; Marcel Dekker, Inc. (1987).			12:41448
	See Sci. Technol., 22: No. 2/3, 165-189(1987)			12:41449
	See Sci. Technol., 22: No. 2/3, 191-214(1987)			12:41450
	See Sci. Technol., 22: No. 2/3, 215-232(1987)			12:41451
	See Sci. Technol., 22: No. 2/3, 233-242(1987)			12:41452
	See Sci. Technol., 22: No. 2/3, 243-267(1987)			12:41453
	See Sci. Technol., 22: No. 2/3, 269-280(1987)			12:41454
	See Sci. Technol., 22: No. 2/3, 281-314(1987)			12:41455
	See Sci. Technol., 22: No. 2/3, 325-334(1987)			12:41456
	See Sci. Technol., 22: No. 2/3, 335-345(1987)			12:41457
	See Sci. Technol., 22: No. 2/3, 347-360(1987)			12:41458
	See Sci. Technol., 22: No. 2/3, 361-372(1987)			12:41459
	See Sci. Technol., 22: No. 2/3, 373-378(1987)			12:41460
	See Sci. Technol., 22: No. 2/3, 379-393(1987)			12:41461
	See Sci. Technol., 22: No. 2/3, 395-415(1987)			12:41462
	See Sci. Technol., 22: No. 2/3, 417-445(1987)			12:41463
	See Sci. Technol., 22: No. 2/3, 447-466(1987)			12:41464
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	See Sci. Technol., 22: No. 2/3, 619-640(1987)			12:41469
	See Sci. Technol., 22: No. 2/3, 641-659(1987)			12:41470
	See Sci. Technol., 22: No. 2/3, 677-689(1987)			12:41471
	See Sci. Technol., 22: No. 2/3, 711-730(1987)			12:41472

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	See Sci. Technol., 22: No. 2/3, 731-743(1987)			12:41473
	See Sci. Technol., 22: No. 2/3, 763-789(1987)			12:41474
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	See Sci. Technol., 22: No. 2/3, 911-919(1987)			12:41479
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	See Sci. Technol., 22: No. 2/3, 973-982(1987)			12:41483
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	See Sci. Technol., 22: No. 2/3, 1037-1063(1987)			12:41487
	See Sci. Technol., 22: No. 2/3, 1087-1101(1987)			12:41488
	See Sci. Technol., 22: No. 2/3, 1103-1120(1987)			12:41489
	See Sci. Technol., 22: No. 2/3, 1135-1148(1987)			12:41490
	See Sci. Technol., 22: No. 2/3, 1149-1167(1987)			12:41491
	See Sci. Technol., 22: No. 2/3, 1183-1197(1987)			12:41492
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	See Sci. Technol., 22: No. 2/3, 701-710(1987)			12:41534
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	See Sci. Technol., 22: No. 2/3, 831-841(1987)			12:41536
	See Sci. Technol., 22: No. 2/3, 1029-1035(1987)			12:41537
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	See Sci. Technol., 22: No. 2/3, 1169-1181(1987)			12:41539
	See Sci. Technol., 22: No. 2/3, 503-511(1987)			12:41657
	See Sci. Technol., 22: No. 2/3, 1121-1134(1987)			12:41658
CONF-851027-	(24. Hanford life sciences symposium and environmental research on complex organic mixtures, Richland, WA, USA, 20-24 Oct 1985)			
13	*See* PNL-SA-13188	E 1.99: DE87012163	MN -48	12:42282
CONF-8510375-	(2. geology South Brazilian symposium, Florianopolis, Brazil, 1 Oct 1985)			
6-Summ.	*See* INIS-BR-664	DE87702772	MN -4	12:41431
CONF-8510453-	(IWL conference on the new legislation on air pollution abatement, Koeln, F.R. Germany, 9 Oct 1985)			
	NTIS (US Sales Only), PC A06; 3	DE87770190	MN -11	12:41942
CONF-8511170-	(Lattice gauge theory: a challenge in large scale computing conference, Wuppertal, F.R. Germany, 5-7 Nov 1985)			
3	*See* CEA-CONF-8315	DE87751805	MN -34D	12:42492
CONF-8511295-	(1. regional meeting of geophysics, Sao Jose dos Campos, Brazil, 27-29 Nov 1985)			
1-Summ.	*See* INIS-BR-654	DE87702762	MN -37	12:41798
2-Summ.	*See* INIS-BR-655	DE87702763	MN -34B	12:42343
3-Summ.	*See* INIS-BR-656	DE87702764	MN -11	12:42026
4-Summ.	*See* INIS-BR-657	DE87702765	MN -37	12:41799
5-Summ.	*See* INIS-BR-658	DE87702766	MN -51	12:40481
6-Summ.	*See* INIS-BR-659	DE87702767	MN -51	12:41949
7-Summ.	*See* INIS-BR-660	DE87702768	MN -34B	12:41930
8-Summ.	*See* INIS-BR-661	DE87702769	MN -34B	12:41931
CONF-8512109-	(SFEN meeting on accidental releases and source terms in case of serious accident in pressurized water reactors, Paris, France, 18 Dec 1985)			
	See CEA-CONF-8813	DE87752283	MN -78	12:40966
CONF-8512129-	(4. congress of scientific and technological engineering, Sao Carlos, Brazil, 1 Dec 1985)			
2-Summ.	*See* INIS-BR-670	DE87702778	MN -25	12:41308
3-Summ.	*See* INIS-BR-671	DE87702779	MN -4	12:41432
4-Summ.	*See* INIS-BR-673	DE87702780	MN -25	12:41309
CONF-8512132-	(4. national meeting of Moessbauer spectroscopy, Rio de Janeiro, Brazil, 11-13 Dec 1985)			
	See INIS-BR-669	DE87702777	MN -34A	12:42357
CONF-860102-	(3. symposium on space nuclear power systems, Albuquerque, NM, USA, 13-16 Jan 1986)			
17	*See* LA-UR-86-145	E 1.99: DE86006015	MN -38	12:41597
CONF-860227-	(5. symposium on atomic and surface physics, Obertraun, Austria, 9-15 Feb 1986)			
1	*See* CEA-CONF-8327	DE87752258	MN -34A	12:42348
CONF-8602131-	(Consultants' meeting on nuclear techniques for analysis of environmental samples, Karlsruhe, F.R. Germany, 19-21 Feb 1986)			
	See IAEA-RL-135	DE87702731	MN -4	12:41419
CONF-8603112-	(Winter school on aperiodic crystals, Les Houches, France, 11-17 Mar 1986)			
2	*See* CEA-CONF-8337	DE87752259	MN -34	12:42638

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CONF-8603114-	(Workshop on relativistic channeling Acquafredda di Maratea, Maratea, Italy, 31 Mar-4 Apr 1986)			
4	*See* SLAC-PUB-4187	E 1.99: DE87010541	MN -28	12:41699
CONF-860418-	(88. annual meeting of the American Ceramic Society, Chicago, IL, USA, 27 Apr-1 May 1986)			
21	*See* HEDL-SA-3447-FP	E 1.99: DE87004093	MN -80	12:40931
26	*See* HEDL-SA-3462	E 1.99: DE87010713	MN -79b	12:40952
CONF-860421-	(2. international conference on fusion reactor materials (ICFRM-2), Chicago, IL, USA, 13-17 Apr 1986)			
	J. Nucl. Mater., 141-143: No. B, 607-610(Nov-Dec 1986)			12:42829
	J. Nucl. Mater., 141-143: No. B, 647-653(Nov-Dec 1986)			12:42830
	J. Nucl. Mater., 141-143: No. B, 686-689(Nov-Dec 1986)			12:42831
	J. Nucl. Mater., 141-143: No. A, 10-18(Nov-Dec 1986)			12:42832
	J. Nucl. Mater., 141-143: No. A, 24-28(Nov-Dec 1986)			12:42833
	J. Nucl. Mater., 141-143: No. A, 29-37(Nov-Dec 1986)			12:42834
	J. Nucl. Mater., 141-143: No. A, 38-43(Nov-Dec 1986)			12:42835
	J. Nucl. Mater., 141-143: No. A, 61-64(Nov-Dec 1986)			12:42836
	J. Nucl. Mater., 141-143: No. A, 65-72(Nov-Dec 1986)			12:42837
	J. Nucl. Mater., 141-143: No. A, 73-75(Nov-Dec 1986)			12:42838
	J. Nucl. Mater., 141-143: No. A, 87-95(Nov-Dec 1986)			12:42839
	J. Nucl. Mater., 141-143: No. A, 108-112(Nov-Dec 1986)			12:42840
	J. Nucl. Mater., 141-143: No. A, 124-130(Nov-Dec 1986)			12:42841
	J. Nucl. Mater., 141-143: No. A, 160-162(Nov-Dec 1986)			12:42842
	J. Nucl. Mater., 141-143: No. A, 169-173(Nov-Dec 1986)			12:42843
	J. Nucl. Mater., 141-143: No. A, 184-187(Nov-Dec 1986)			12:42844
	J. Nucl. Mater., 141-143: No. A, 188-192(Nov-Dec 1986)			12:42845
	J. Nucl. Mater., 141-143: No. A, 221-225(Nov-Dec 1986)			12:42846
	J. Nucl. Mater., 141-143: No. A, 229-233(Nov-Dec 1986)			12:42847
	J. Nucl. Mater., 141-143: No. A, 271-274(Nov-Dec 1986)			12:42848
	J. Nucl. Mater., 141-143: No. A, 282-288(Nov-Dec 1986)			12:42849
	J. Nucl. Mater., 141-143: No. A, 305-310(Nov-Dec 1986)			12:42850
	J. Nucl. Mater., 141-143: No. A, 311-315(Nov-Dec 1986)			12:42851
	J. Nucl. Mater., 141-143: No. A, 316-320(Nov-Dec 1986)			12:42852
	J. Nucl. Mater., 141-143: No. A, 344-347(Nov-Dec 1986)			12:42853
	J. Nucl. Mater., 141-143: No. A, 348-352(Nov-Dec 1986)			12:42854
	J. Nucl. Mater., 141-143: No. A, 382-386(Nov-Dec 1986)			12:42855
	J. Nucl. Mater., 141-143: No. A, 401-404(Nov-Dec 1986)			12:42856
	J. Nucl. Mater., 141-143: No. A, 468-475(Nov-Dec 1986)			12:42857
	J. Nucl. Mater., 141-143: No. A, 523-526(Nov-Dec 1986)			12:42858
	J. Nucl. Mater., 141-143: No. A, 548-552(Nov-Dec 1986)			12:42859
	J. Nucl. Mater., 141-143: No. A, 553-558(Nov-Dec 1986)			12:42860
CONF-860462-	(Applied geodesy for particle accelerators, Geneva, Switzerland, 14-18 Apr 1986)			
	See CERN-87-01	DE87702667	MN -51	12:41683
CONF-8604321-	(2. image symposium: international electronic image week, Nice, France, 21-25 Apr 1986)			
1	*See* CEA-CONF-8750	DE87752255	MN -48	12:42062
2	*See* CEA-CONF-8751	DE87752256	MN -48	12:42063
CONF-8604340-	(Seminar on atmospheric fluidized-bed combustion technology for utility applications, Palo Alto, CA, USA, 8-10 Apr 1986)			
	See EPRI-CS-5186	TI87920515	ND -103	12:40407

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CONF-8604341-	(Electromagnetic Compatibility Society Institute for Electrical and Electronics Engineers, San Jose, CA, USA, 29-30 Apr 1986)			
1	*See* UCRL-94285	DE87009561	MN -38	12:41613
CONF-860583-	(International Committee for Future Accelerators workshop on superconducting magnets and cryogenics, Upton, NY, USA, 12-16 May 1986)			
7	*See* CEA-CONF-8743	DE87751633	MN -28	12:41685
CONF-8605122-	(4. symposium on energy engineering sciences: chemical processes and control - non-linear systems, Argonne, IL, USA, 7-9 May 1986)			
5	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011173	MN -38	12:42874
CONF-8605182-	(7. Vanderbilt high energy physics conference, Nashville, TN, USA, 15-17 May 1986)			
	NTIS, PC A15/MF A01; 1 (GPO Dep.)	E 1.99: DE87012199	MN -34D	12:42408
CONF-8605282-	(Wind and solar short course, Modena, Italy, 5-9 May 1986)			
1	*See* PNL-SA-14865	E 1.99: DE87011985	MN -60	12:40742
CONF-860605-	(13. international symposium on the effects of radiation on materials, Seattle, WA, USA, 23-25 Jun 1986)			
44	*See* HEDL-SA-3548	E 1.99: DE87011480	MN -80	12:41306
CONF-860629-	(Linear accelerator conference, Stanford, CA, USA, 2-6 Jun 1986)			
75	*See* DOE/ER/40150-14	DE87008661	MN -28	12:41688
76	*See* DOE/ER/40150-11	DE87008660	MN -28	12:41687
CONF-860665-	(6. international conference on high power particle beams, Kobe, Japan, 9-12 Jun 1986)			
20	*See* UCRL-94641	E 1.99: DE87011566	MN -21	12:42806
CONF-8606259-	(Theoretical Advanced Study Institute conference, Santa Cruz, CA, USA, 23 Jun-29 Jul 1986)			
7	*See* LBL-22404	E 1.99: DE87007608	MN -34D	12:42475
CONF-8606315-	(IFAC symposium on distributed parameter systems, Los Angeles, CA, USA, 1 Jun 1986)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011170	MN -38	12:42875
CONF-8606316-	(6. Mach reflection symposium, Beer Sheva, Israel, 29 Jun-4 Jul 1986)			
Absts.	*See* INIS-mf-10918	DE87780149	MN -34C	12:42402
CONF-8606317-	(Electromagnetic wave propagation panel symposium, Hague, Netherlands, 2-6 Jun 1986)			
1	*See* UCRL-94285	DE87009561	MN -38	12:41613
CONF-8606325-	(4. All-Union conference on radiative defects in metals, Alma-Ata, USSR, 1 Jun 1986)			
1	*See* JINR-14-86-409	DE87702820	MN -25	12:41313
2	*See* JINR-14-86-410	DE87702821	MN -25	12:41314
CONF-8607333-	(Research co-ordination meeting on studies of agricultural chemical residues in meat, milk and related products of livestock with the aid of nuclear techniques, Belgrade, Yugoslavia, 16-19 Jul 1986)			
Summ.	*See* IAEA-TECDOC-406	DE87702735	MN -48	12:42262
CONF-860807-	(6. international workshop on inelastic ion surface collisions, Argonne, IL, USA, 25-29 Aug 1986)			
3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011349	MN -20c	12:41285
CONF-860810-	(Intersociety energy conversion engineering conference, San Diego, CA, USA, 25-29 Aug 1986)			
49	*See* HEDL-SA-3526	E 1.99: DE87010728	MN -80	12:40881
CONF-860879-	(International conference on martensitic transformations (ICOMAT-86), Nara, Japan, 26-30 Aug 1986)			
6	*See* KU-HCOE-FL2-R-86-4	DE87752336	MN -34A	12:42684
CONF-8608121-	(11. international congress on X-ray optics and microanalysis, London, Canada, 4 Aug 1986)			
2	*See* CEA-CONF-8781	DE87752252	MN -37	12:41836
CONF-8608146-	(Low-dimensional conductors and superconductors, Quebec, Canada, 24 Aug-6 Sep 1986)			
2	*See* BNL-39911	E 1.99: DE87011294	MN -34	12:42694
CONF-8608158-	(Liquid and amorphous metals 6, Garmisch, Partenkirchen, F.R. Germany, 25-29 Aug 1986)			
2	*See* CEA-CONF-8622	DE87752251	MN -25	12:41284
CONF-8608177-	(IAU symposium on observational cosmology, Beijing, China, 25-30 Aug 1986)			
1	*See* CEA-CONF-8700	DE87752253	MN -34B	12:42313
CONF-860919-	(6. international symposium on gas flow and chemical lasers, Jerusalem, Israel, 8-12 Sep 1986)			
Absts.	*See* INIS-mf-10917	DE87780153	MN -38	12:41625
CONF-860921-	(ISEC '86: international solvent extraction conference, Munich, F.R. Germany, 11-16 Sep 1986)			
8	*See* RCM-01886	DE87751895	MN -86	12:40491
CONF-860931-	(International conference on reliable fuels for liquid metal reactors, Tucson, AZ, USA, 7-11 Sep 1986)			
24	*See* HEDL-SA-3497	E 1.99: DE87010719	MN -79b	12:40953
CONF-860932-	(Radiological accidents, perspectives and emergency planning preparedness, Bethesda, MD, USA, 15-17 Sep 1986)			
8	*See* PNL-SA-13791	E 1.99: DE87012059	MN -41	12:40655

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CONF-8609126-	(Committee on the Safety of Nuclear Installations (CSNI) specialists' meeting on core debris/concrete interactions, Palo Alto, CA, USA, 3-5 Sep 1986)			
6	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87004719	MN -4	12:40985
7	*See* CEA-CONF-8816	DE87752282	MN -78	12:40967
CONF-8609132-	(Resonance ionization spectroscopy and its application, Swansea, UK, 7-12 Sep 1986)			
16	*See* PNL-SA-13786	DE87012060	MN -34A	12:42362
CONF-8609134-	(Geochemical modelling workshop, Fallen Leaf Lake, CA, USA, 14-17 Sep 1986)			
Absts.	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87012570	MN -11	12:42309
CONF-8609138-	(5. europhysical topical conference on lattice defects in ionic materials, Madrid, Spain, 8-12 Sep 1986)			
7-Summ.	*See* INIS-BR-648	DE87702757	MN -34A	12:42651
CONF-8609146-	(Microgravity fluid management symposium, Cleveland, OH, USA, 9 Sep 1986)			
1	*See* PNL-SA-14228	E 1.99: DE86015530	MN -80	12:40960
CONF-8609233-	(Vibration conference, Boston, MA, USA, 27-30 Sep 1986)			
1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87004844	MN -80	12:40915
CONF-8609234-	(International collaboration on advanced neutron sources, Villigen, Switzerland, 22-26 Sep 1986)			
8	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87011351	MN -28	12:41738
9	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87011350	MN -28	12:41739
CONF-8609280-	(Congress of European Society for Neurochemistry, Prague, Czechoslovakia, 1-6 Sep 1986)			
1	*See* CEA-CONF-8740	DE87752261	MN -48	12:42061
CONF-8609282-	(1. non destructive testing congress for Latin America and Caribbe, Sao Paulo, Brazil, 21-24 Sep 1986)			
2-Summ.	*See* INIS-BR-625	DE87702756	MN -37	12:41797
CONF-8609283-	(Workshop on vertex detectors: state of the art and perspectives, Erice, Italy, 21-26 Sep 1986)			
1	*See* SLAC-PUB-4318	DE87010311	MN -28	12:41831
CONF-8609295-	(4. international conference on molecular beam epitaxy (MBE-4) and exhibition, York, UK, 7-10 Sep 1986)			
	J. Cryst. Growth, 81: No. 1-4, 359-367(Feb 1987)			12:41417
CONF-8609300-	(8. European conference on earthquake engineering, Lisbon, Portugal, 7-12 Sep 1986)			
1	*See* CEA-CONF-8817	DE87752532	MN -11	12:42293
CONF-8609306-	(Symposium on carcinogenesis, Toronto, Canada, 22 Sep 1986)			
1	RCPSC, 74 Stanley Ave., Ottawa, Ontario, KIM1P4, Canada	TI87011686	ND -48	12:42191
CONF-8609314-	(Geotechnology workshop on compressed-air energy storage in porous media sites, Traverse City, MI, USA, 23-24 Sep 1986)			
	See EPRI-AP-5301	TI87920526	ND -94e	12:41082
CONF-861007-	(Nuclear science and nuclear power systems symposium, Washington, DC, USA, 29-31 Oct 1986)			
28	*See* UND-HEP-86-AR00	E 1.99: DE87009753	MN -37	12:41832
29	*See* UND-HEP-86-RR03	E 1.99: DE87009754	MN -37	12:41833
CONF-861036-	(Role of organic and inorganic colloids in subsurface transport, Manteo, NC, USA, 5-9 Oct 1986)			
Summ.	*See* DOE/ER-0331	E 1.99: DE87012029	MN -11	12:41973
CONF-861044-	(Hanford Life Sciences symposium: radiation protection-a look to the future - celebrating four decades of research at Hanford, Richland, WA, USA, 21-23 Oct 1986)			
9	*See* PNL-SA-13184	E 1.99: DE87012171	MN -48	12:42281
CONF-861048-	(3. Brazilian petroleum congress, Rio de Janeiro, Brazil, 5-10 Oct 1986)			
2	*See* INIS-BR-653	DE87702761	MN -4	12:41430
CONF-861063-	(American Society of Metals materials week, Lake Buena Vista, FL, USA, 6-9 Oct 1986)			
5	*See* KU-HCOE-FL2-R-86-13	DE87752335	MN -25	12:41316
CONF-8610160-	(IAEA technical committee meeting on gas-cooled reactors and their applications, Juelich, F.R. Germany, 20-23 Oct 1986)			
	Combustion Institute, Western States Sect., c/o L.S. Caretto, Calif. State Univ., Northridge, CA 91330			12:42770
CONF-8610180-	(Fall meeting of the Western States Section/Combustion Institute, Tucson, AZ, USA, 27-28 Oct 1986)			
	Combustion Institute, Western States Sect., c/o L.S. Caretto, Calif. State Univ., Northridge, CA 91330			12:40413
	Combustion Institute, Western States Sect., c/o L.S. Caretto, Calif. State Univ., Northridge, CA 91330			12:40683
	Combustion Institute, Western States Sect., c/o L.S. Caretto, Calif. State Univ., Northridge, CA 91330			12:41576
	Combustion Institute, Western States Sect., c/o L.S. Caretto, Calif. State Univ., Northridge, CA 91330			12:41926

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CONF-8610210-	(23. joint Army Navy NASA Air Force combustion meeting (JANNAF), Hampton, VA, USA, 20-24 Oct 1986)				
2	NTIS, PC A02; 3		DE87011355	MN -38	12:41573
CONF-8610219-	(33. annual meeting of the American Astronautical Society - aerospace: century 21, Boulder, CO, USA, 27 Oct 1986, 27 Oct 1986)				
1	*See* PNL-SA-14372	E 1.99:	DE87002711	MN -80	12:40882
CONF-8610239-	(Symposium celebrating 35 years of electron scattering in nuclear and particle science, Urbana, IL, USA, 23-24 Oct 1986)				
3	*See* DOE/ER/40150-21	E 1.99:	DE87008669	MN -28	12:41689
CONF-8610245-	(Workshop on neutron physics, Budapest, Hungary, 8-10 Oct 1986)				
2	*See* CEA-CONF-8729		DE87752254	MN -37	12:41789
CONF-861114-	(9. international conference on application of accelerators in research and industry, Denton, TX, USA, 10-12 Nov 1986)				
	Nucl. Instrum. Methods Phys. Res., Sect. B, 24/25: No. 2, 937-943(Apr 1987)				12:41348
	Nucl. Instrum. Methods Phys. Res., Sect. B, 24/25: No. 2, 698-700(Apr 1987)				12:41445
	Nucl. Instrum. Methods Phys. Res., Sect. B, 24/25: No. 2, 1006-1009(Apr 1987)				12:41446
	Nucl. Instrum. Methods Phys. Res., Sect. B, 24/25: No. 2, 725-729(Apr 1987)				12:41702
	Nucl. Instrum. Methods Phys. Res., Sect. B, 24/25: No. 2, 736-740(Apr 1987)				12:41703
	Nucl. Instrum. Methods Phys. Res., Sect. B, 24/25: No. 2, 1087-1091(Apr 1987)				12:41704
	Nucl. Instrum. Methods Phys. Res., Sect. B, 24/25: No. 2, 826-833(Apr 1987)				12:41772
	Nucl. Instrum. Methods Phys. Res., Sect. B, 24/25: No. 2, 841-844(Apr 1987)				12:41773
	Nucl. Instrum. Methods Phys. Res., Sect. B, 24/25: No. 2, 852-854(Apr 1987)				12:41774
	Nucl. Instrum. Methods Phys. Res., Sect. B, 24/25: No. 2, 855-857(Apr 1987)				12:41775
	Nucl. Instrum. Methods Phys. Res., Sect. B, 24/25: No. 2, 746-751(Apr 1987)				12:41776
	Nucl. Instrum. Methods Phys. Res., Sect. B, 24/25: No. 2, 863-867(Apr 1987)				12:41777
	Nucl. Instrum. Methods Phys. Res., Sect. B, 24/25: No. 2, 897-900(Apr 1987)				12:41778
	Nucl. Instrum. Methods Phys. Res., Sect. B, 24/25: No. 2, 905-908(Apr 1987)				12:41779
	Nucl. Instrum. Methods Phys. Res., Sect. B, 24/25: No. 2, 925-927(Apr 1987)				12:41780
	Nucl. Instrum. Methods Phys. Res., Sect. B, 24/25: No. 2, 963-966(Apr 1987)				12:41781
	Nucl. Instrum. Methods Phys. Res., Sect. B, 24/25: No. 2, 695-697(Apr 1987)				12:41782
	Nucl. Instrum. Methods Phys. Res., Sect. B, 24/25: No. 2, 672-675(Apr 1987)				12:41834
	Nucl. Instrum. Methods Phys. Res., Sect. B, 24/25: No. 2, 1063-1067(Apr 1987)				12:42174
	Nucl. Instrum. Methods Phys. Res., Sect. B, 24/25: No. 2, 1050-1053(Apr 1987)				12:42253
56	NTIS, PC A02; 3		DE87011685	MN -34A	12:42350
CONF-861185-	(Reduced Enrichment for Research and Test Reactors (RERTR) program international meeting, Gatlinburg, TN, USA, 3-6 Nov 1986)				
4	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87004924	MN -80	12:40946
5	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87004925	MN -80	12:40927
10	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87004702	MN -80	12:40947
CONF-8611145-	(11. modern engineering and technology (METS-86), Taitei, Taiwan, 17-28 Nov 1986)				
1	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE87004750	MN -80	12:40940
CONF-861204-	(4. Miami international symposium on multi-phase transport and particulate phenomena, Miami Beach, FL, USA, 15-17 Dec 1986)				
10	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011352	MN -38	12:41639
CONF-861207-	(Materials Research Society fall meeting, Boston, MA, USA, 1-5 Dec 1986)				
111	*See* UCRL-94721		DE87012244	MN -70	12:40565
112	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012533	MN -25	12:41286
CONF-861257-	(4. rapid solidification conference, Santa Barbara, CA, USA, 14-18 Dec 1986)				
2	*See* LA-UR-87-2449	E 1.99:	DE87013161	MN -25	12:41319
CONF-861293-	(10. international online information meeting, London, UK, 2-4 Dec 1986)				
1	*See* UCRL-95039		DE87011880	MN -13	12:42903

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CONF-870102-	(4. symposium on space nuclear power systems, Albuquerque, NM, USA, 12-16 Jan 1987)				
7	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87002409	MN -80	12:41287
12	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87007005	MN -80	12:40948
14	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87006985	MN -80	12:40880
15	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87006987	MN -80	12:40933
22-Rev.1	*See* UCRL-93501-Rev.1	E 1.99:	DE87009740	MN -33A	12:41077
26	*See* SAND-86-1813C	E 1.99:	DE87011311	MN -38	12:40883
28	*See* SAND-87-0637C	E 1.99:	DE87012975	MN -38	12:40884
CONF-870114-	(IEEE/OSA topical meeting on picosecond electronics and optoelectronics, Lake Tahoe, NV, USA, 14-16 Jan 1987)				
4	*See* UCRL-95287	E 1.99:	DE87011877	MN -38	12:41399
CONF-870219-	(20. midyear topical symposium of the Health Physics Society: health physics of radiation-producing machines, Reno, NV, USA, 8-12 Feb 1987)				
11	*See* SLAC-PUB-4150		DE87010320	MN -34D	12:42476
CONF-870247-	(International Rosenbluth symposium on dynamics of particles and plasmas, Austin, TX, USA, 2-5 Feb 1987)				
3	*See* UCRL-96050	E 1.99:	DE87011546	MN -20a	12:42752
CONF-870272-	(American Institute of Metallurgical Engineers annual meeting: light metals session, Denver, CO, USA, 22-26 Feb 1987)				
5	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011491	MN -25	12:41288
CONF-870278-	(4. family of quarks and leptons international symposium, Santa Monica, CA, USA, 26-28 Feb 1987)				
5	*See* FNAL/C-87/83	E 1.99:	DE87011069	MN -34D	12:42421
CONF-870282-	(8. summer school of nuclear and particle physics, Launceston, Australia, 2-6 Feb 1987)				
2	*See* SLAC-PUB-4342		DE87012318	MN -34C	12:42609
CONF-870283-	(BNL neutrino workshop, Upton, NY, USA, 5-7 Feb 1987)				
	See BNL-52079	E 1.99:	DE87012506	MN -34D	12:42415
10	*See* ANL-HEP-CP-87-42		DE87011542	MN -34D	12:42409
CONF-870288-	(TIBER/ETR design meeting, Livermore, CA, USA, 9-10 Feb 1987)				
3-Vugraphs	NTIS, PC A02; 3		DE87008784	MN -20	12:40949
CONF-870294-	(International seminar on scientific supercomputers, Paris, France, 2-6 Feb 1987)				
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011485	MN -32	12:42868
CONF-870295-	(Technical seminar on chemical spills, Toronto, Canada, 9-12 Feb 1987)				
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011486	MN -37	12:41837
CONF-870302-	(Particle accelerator conference, Washington, DC, USA, 16-19 Mar 1987)				
162	*See* LBL-22203		DE87009328	MN -28	12:41760
181	*See* SLAC-PUB-4176	E 1.99:	DE87009891	MN -28	12:41698
186	*See* LBL-22243	E 1.99:	DE87010256	MN -28	12:41695
187	*See* LBL-22272	E 1.99:	DE87010261	MN -28	12:42796
189	*See* BNL-39673	E 1.99:	DE87010455	MN -28	12:41734
191	*See* SLAC-PUB-4093		DE87010322	MN -28	12:41720
193	*See* SLAC-PUB-4229		DE87010317	MN -28	12:41767
194	*See* BNL-39648		DE87010067	MN -28	12:41733
196	*See* SLAC-PUB-4262	E 1.99:	DE87010544	MN -28	12:41769
198	*See* SLAC-PUB-4310		DE87010314	MN -28	12:41700
199	*See* SLAC-PUB-4247		DE87010316	MN -28	12:41768
201	*See* DOE/ER/40150-20		DE87008663	MN -28	12:41740
204	*See* LBL-23160	E 1.99:	DE87010974	MN -28	12:41761
206	*See* SLAC-PUB-4181		DE87011587	MN -28	12:41723
207	*See* SLAC-PUB-4182		DE87011588	MN -28	12:41724
209	*See* ANL-HEP-CP-87-21		DE87011509	MN -28	12:41785
210	NTIS, PC A02; 3		DE87011499	MN -28	12:41737
211	NTIS, PC A02; 3		DE87011500	MN -28	12:41686
213	*See* ANL-HEP-CP-87-24		DE87011503	MN -28	12:41708
214	*See* ANL-HEP-CP-87-14		DE87011513	MN -28	12:41684
215	*See* ANL-HEP-87-30		DE87011507	MN -28	12:41784
216	NTIS, PC A02; 3		DE87011506	MN -28	12:41787
217	*See* ANL-HEP-CP-87-27		DE87011502	MN -28	12:41709
218	*See* ANL-HEP-CP-87-22		DE87011494	MN -28	12:41732
219	*See* ANL-HEP-CP-87-20		DE87011495	MN -28	12:41731
222	*See* BNL-39896		DE87011303	MN -28	12:41786
232	*See* LA-UR-87-1967		DE87011780	MN -34A	12:42361
239	*See* TRI-PP-87-26		DE87900865	MN -28	12:41771
CONF-870306-	(Waste management '87, Tucson, AZ, USA, 1-5 Mar 1987)				
39	*See* UNI-SA-203	E 1.99:	DE87006591	MN -80	12:40964
CONF-870320-	(Department of Energy international workshop on two-phase flow fundamentals, Troy, NY, USA, 16 Mar 1987)				
3	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011498	MN -38	12:41640
CONF-870334-	(Workshop on results and perspectives in particle physics, La Thuile, Italy, 1-7 Mar 1987)				
2	*See* SLAC-PUB-4327		DE87011595	MN -34D	12:42477

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CONF-870339-	(Moriond meeting on hadrons, quarks and gluons, Les Arcs, France, 15-21 Mar 1987)			
2	*See* ANL-HEP-CP-87-51	E 1.99: DE87011539	MN -34D	12:42410
CONF-870390-	(22. Recontres de Moriond: electroweak interactions and unified theories conference, Les Arcs, France, 8-15 Mar 1987)			
8	*See* SLAC-PUB-4326	E 1.99: DE87011594	MN -28	12:41701
9	*See* SLAC-PUB-4328	E 1.99: DE87012834	MN -34D	12:42431
CONF-8703121-	(Telemark IV - neutrino mass and neutrino astrophysics, Ashland, WI, USA, 16-18 Mar 1987)			
4	*See* BNL-39960	DE87012479	MN -34C	12:42414
CONF-8703128-	(International conference on advances in experimental methods for colliding beam physics, Stanford, CA, USA, 9-13 Mar 1987)			
2	*See* FNAL/C-87/62	DE87009436	MN -37	12:41742
6	*See* SLAC-PUB-4255	DE87011589	MN -37	12:41830
CONF-8703131-	(19. symposium on the interface of computer science and statistics, Philadelphia, PA, USA, 8-11 Mar 1987)			
2	*See* PNL-SA-14590	E 1.99: DE87011989	MN -32	12:42888
CONF-8703136-	(Elementary structure of materials, Les Houches, France, 24 Mar-2 Apr 1987)			
4	*See* LA-UR-87-2096	E 1.99: DE87011762	MN -34D	12:42474
CONF-8703140-	(Field task proposal agreement review meeting, Washington, DC, USA, 24 Mar 1987)			
2-Vugraphs	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87008791	MN -20b	12:42775
CONF-8703142-	(New trends in genetic risk assessment meeting, Nice, France, 9-11 Mar 1987)			
2	*See* UCRL-96858	DE87012241	MN -48	12:42048
CONF-8703143-	(Workshop on superstrings, composite structures, and cosmology, College Park, MD, USA, 11-18 Mar 1987)			
2	*See* SLAC-PUB-4344	E 1.99: DE87012831	MN -34D	12:42506
CONF-8703145-	(Workshop on heavy-ion reaction dynamics studies with large counter arrays, Toronto, Canada, 27 Mar 1987)			
1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87010905	MN -34C	12:42586
CONF-8703151-	(3. PEF status colloquium of Kernforschungszentrum Karlsruhe G.m.b.H., Karlsruhe, F.R. Germany, 10-12 Mar 1987)			
Summs.	NTIS (US Sales Only), PC A05/MF A01; 1	DE87770188	MN -11	12:41873
CONF-8703156-	(Workshop on the influence of neutron spectra on experimental measurements, Tucson, AZ, USA, 23-27 Mar 1987)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012540	MN -46	12:40900
CONF-870405-	(Topical conference on theory and practice in radiation protection and shielding, Knoxville, TN, USA, 22-24 Apr 1987)			
15	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011531	MN -20	12:42771
CONF-870410-	(193. national meeting of the American Chemical Society, Denver, CO, USA, 5-10 Apr 1987)			
	Prepr. Pap., Am. Chem. Soc., Div. Fuel Chem., 32: No. 2, 167-177(Apr 1987)			12:40707
	Prepr. Pap., Am. Chem. Soc., Div. Fuel Chem., 32: No. 2, 143-147(Apr 1987)			12:40708
	Prepr. Pap., Am. Chem. Soc., Div. Fuel Chem., 32: No. 2, 106-116(Apr 1987)			12:40709
	Prepr. Pap., Am. Chem. Soc., Div. Fuel Chem., 32: No. 2, 82-89(Apr 1987)			12:40710
	Prepr. Pap., Am. Chem. Soc., Div. Fuel Chem., 32: No. 2, 68-81(Apr 1987)			12:40711
	Prepr. Pap., Am. Chem. Soc., Div. Fuel Chem., 32: No. 2, 21-28(Apr 1987)			12:40712
	Prepr. Pap., Am. Chem. Soc., Div. Fuel Chem., 32: No. 2, 297-307(Apr 1987)			12:40713
	Prepr. Pap., Am. Chem. Soc., Div. Fuel Chem., 32: No. 2, 287-296(Apr 1987)			12:40714
	Prepr. Pap., Am. Chem. Soc., Div. Fuel Chem., 32: No. 2, 249-256(Apr 1987)			12:40715
30	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87011414	MN -20d	12:42772
34	*See* LBL-23415	E 1.99: DE87010259	MN -34C	12:42608
36	*See* SAND-87-1894C	E 1.99: DE87013068	MN -25	12:41398
CONF-870412-	(General meeting of the American Physical Society, Crystal City, VA, USA, 20-24 Apr 1987)			
2	*See* LBL-23585	E 1.99: DE87012893	MN -4	12:41500
3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012207	MN -13	12:41278
CONF-870413-	(11. international conference on particles and nuclei, Kyoto, Japan, 20-24 Apr 1987)			
5-Prepr.	*See* GSI-87-17-Prepr.		ND -28	12:41692
CONF-870415-	(American power conference, Chicago, IL, USA, 27-29 Apr 1987)			
3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011411	MN -79p	12:40970

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CONF-870419-	(Topical meeting on anticipated and abnormal transients in nuclear power plants, Atlanta, GA, USA, 12-15 Apr 1987)			
6	NTIS, PC A02; 3	DE87011410	MN -79	12:40971
7	*See* DP-MS-86-219	E 1.99: DE87011241	MN -80	12:40916
CONF-870424-	(American Nuclear Society international meeting on advances in reactor physics, mathematics and computation, Paris, France, 27-30 Apr 1987)			
2	*See* SAND-86-2364C	E 1.99: DE87001730	MN -80	12:40908
14	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87011533	MN -79	12:40972
CONF-870430-	(International conference on methods and applications of radioanalytical chemistry, Kona, HI, USA, 5-10 Apr 1987)			
11	*See* PNL-SA-14316	E 1.99: DE87011144	MN -11	12:41826
14	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011409	MN -20c	12:41289
CONF-870436-	(Spring meeting of the Materials Research Society, Anaheim, CA, USA, 21-25 Apr 1987)			
31	*See* SAND-86-2666C	E 1.99: DE87012016	MN -25	12:41365
32	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011640	MN -25	12:41378
CONF-870443-	(2. international conference on the basic and applied chemistry of f-transition and related elements, Lisbon, Portugal, 6-10 Apr 1987)			
3	*See* UCRL-96374	E 1.99: DE87012903	MN -4	12:40684
CONF-870448-	(Workshop on muon-catalyzed fusion and fusion with polarized nuclei, Erice, Italy, 3-9 Apr 1987)			
1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87010472	MN -34C	12:42585
CONF-870463-	(5. Institute of Physics conference on microscopy of semiconducting materials, Oxford, UK, 6-8 Apr 1987)			
1-Draft	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012534	MN -25	12:41379
CONF-870472-	(Eastern simulation conference, Orlando, FL, USA, 6-9 Apr 1987)			
3	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87011524	MN -79	12:40973
CONF-8704112-	(4. international symposium on accelerator mass spectrometry, Ontario, Canada, 27-30 Apr 1987)			
7	*See* LBL-23324	E 1.99: DE87011215	MN -28	12:41696
CONF-8704113-	(Contractors nuclear criticality safety meeting, Las Vegas, NV, USA, 27 Apr 1987)			
2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012527	MN -46	12:40901
CONF-8704144-	(IMOG subgroup on cleaning meeting, Oak Ridge, TN, USA, 22-23 Apr 1987)			
1	*See* DP-MS-87-39	E 1.99: DE87010200	MN -38	12:41592
CONF-8704161-	(21. aerospace mechanisms symposium, Houston, TX, USA, 29 Apr-1 May 1987)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010895	MN -38	12:41588
CONF-8704165-	(Cray User Group spring meeting, New York City, NY, USA, 21-25 Apr 1987)			
1	*See* UCRL-96836	E 1.99: DE87011563	MN -32	12:42893
CONF-8704177-	(2. international conference on hadron spectroscopy, Tsukuba, Japan, 16-18 Apr 1987)			
1	*See* BNL-39953	E 1.99: DE87012496	MN -34D	12:42411
2	*See* BNL-39955	DE87012495	MN -34D	12:42413
3	*See* SLAC-PUB-4340	E 1.99: DE87012832	MN -34D	12:42432
4	*See* BNL-39954	E 1.99: DE87012497	MN -34D	12:42412
CONF-8704179-	(2. Pacific Basin biofuel workshop, Kauai, HI, USA, 22-24 Apr 1987)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011656	MN -61	12:40694
CONF-870505-	(32. international gas turbine conference and exhibition, Anaheim, CA, USA, 31 May-4 Jun 1987)			
1	*See* GA-A-18566	DE87003847	MN -77	12:40862
CONF-870525-	(Workshop on development of personnel neutron dosimeters based on track etch detectors, Harwell, UK, 12-14 May 1987)			
2	*See* PNL-SA-14764	E 1.99: DE87012161	MN -41	12:42246
CONF-870530-	(34. international technical communication conference, Denver, CO, USA, 10-13 May 1987)			
2	*See* UNI-SA-184	E 1.99: DE87003839	MN -80	12:40897
CONF-870543-	(2. workshop on experiments and detectors for relativistic heavy ion collider, Berkeley, CA, USA, 25-29 May 1987)			
1	*See* BNL-39914	E 1.99: DE87011289	MN -34D	12:42583
CONF-870544-	(41. annual quality conference, Minneapolis, MN, USA, 4-6 May 1987)			
4	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012217	MN -38	12:41577
CONF-870582-	(5. conference on real-time computer applications in nuclear, particle, and plasma physics, San Francisco, CA, USA, 11-15 May 1987)			
19	NTIS, PC A02; 3	DE87011429	MN -32	12:42869
20	*See* UCRL-96186	E 1.99: DE87011545	MN -32	12:42892
CONF-870560-	(171. Electrochemical Society meeting, Philadelphia, PA, USA, 10-15 May 1987)			
3	*See* LA-UR-87-2393	E 1.99: DE87013160	MN -93	12:41132
4	*See* LA-UR-87-2285	DE87013143	MN -94cc	12:41131

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CONF-870570-	(7. topical conference on applications of radio-frequency power to plasmas, Kissimmee, FL, USA, 4-6 May 1987)			
19	*See* GA-A-18861	E 1.99: DE87011834	MN -20a	12:42720
CONF-870595-	(DOE/BES atomic physics program workshop, Cambridge, MA, USA, 21-22 May 1987)			
2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011421	MN -34A	12:42351
CONF-870598-	(4. conference on utility experience in reactor noise analysis, Hartford, CT, USA, 12-14 May 1987)			
2	*See* DOE/NE/37959-5	DE87011871	MN -80	12:40951
CONF-8705103-	(Fossil energy materials program conference, Oak Ridge, TN, USA, 19-21 May 1987)			
1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87012257	MN -106	12:40323
9	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87012929	MN -114	12:41292
10	*See* PNL-SA-14930	E 1.99: DE87013326	MN -114	12:41364
CONF-8705106-	(International workshop on micro and macroscopic approaches to detonation, Megeve, France, 31 May-6 Jun 1987)			
3	*See* UCRL-96514	E 1.99: DE87013111	MN -45	12:41861
CONF-8705114-	(35. conference on mass spectrometry and applied topics, Denver, CO, USA, 24-29 May 1987)			
5	*See* PNL-SA-14650	E 1.99: DE87013325	MN -102	12:40357
CONF-8705130-	(International conference on laser advanced materials processing: science and applications, Osaka, Japan, 21-23 May 1987)			
1	*See* SAND-86-2219C	DE87008507	MN -38	12:41324
CONF-8705146-	(International symposium on muon catalyzed fusion, MCF-87, Leningrad, USSR, 26-29 May 1987)			
1	*See* BNL-39878	E 1.99: DE87011298	MN -20	12:42347
CONF-8705147-	(Piecing the puzzle together: a conference on integrating data for decisionmaking, Washington, DC, USA, 27-29 May 1987)			
2	*See* LBL-23629	E 1.99: DE87012883	MN -41	12:42269
CONF-8705148-	(NASA conference on structural integrity and durability of reusable space propulsion systems, Cleveland, OH, USA, 11-12 May 1987)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011418	MN -38	12:41641
CONF-8705150-	(International seminar on transient phenomena in multiphase flow, Belgrade, Yugoslavia, 25-29 May 1987)			
1	NTIS, PC A02; 3	DE87011430	MN -80	12:40986
CONF-8705160-	(7. North American conference on mycorrhizae, Gainesville, FL, USA, 3-8 May 1987)			
1	NTIS, PC A02; 3	DE87011451	MN -11	12:41946
CONF-8705163-	(From colliders to supercolliders workshop, Madison, WI, USA, 11-22 May 1987)			
1	*See* BNL-39968	E 1.99: DE87012486	MN -34D	12:42441
2	*See* BNL-39947	E 1.99: DE87012868	MN -34D	12:42440
CONF-870601-	(Annual meeting of the American Nuclear Society, Dallas, TX, USA, 7-12 Jun 1987)			
18	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011439	MN -79p	12:40974
20	*See* BNL-NUREG-39945	DE87012117	MN -78	12:40886
21	*See* DP-MS-86-214	E 1.99: DE87012942	MN -11	12:41929
CONF-870607-	(International symposium on gyrotrone and free electron laser, Chengdu, China, 1-5 Jun 1987)			
1	*See* GA-A-18854	E 1.99: DE87011328	MN -20a	12:42778
CONF-870610-	(5. national synchrotron radiation instrumentation conference, Madison, WI, USA, 21-25 Jun 1987)			
2	*See* BNL-39890	E 1.99: DE87011299	MN -28	12:41736
6	*See* BNL-39996	E 1.99: DE87012483	MN -25	12:41418
CONF-870620-	(American Society of Heating, Refrigerating and Air-Conditioning Engineers meeting, Nashville, TN, USA, 28 Jun-2 Jul 1987)			
6	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87010908	MN -38	12:41585
CONF-870621-	(78. International District Heating and Cooling Association conference, Baltimore, MD, USA, 21-25 Jun 1987)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011390	MN -37	12:41252
CONF-870622-	(19. fluid dynamics, plasma dynamics, and laser conference, Honolulu, HI, USA, 8-10 Jun 1987)			
7	*See* LA-UR-87-1929	E 1.99: DE87011786	MN -20d	12:42748
CONF-870629-	(14. European conference on controlled fusion and plasma physics, Madrid, Spain, 22-26 Jun 1987)			
9	*See* GA-A-18864	E 1.99: DE87011833	MN -20	12:42721
CONF-870631-	(8. US symposium on compact toroid research and the 9. US/Japan workshop on compact toroids, College Park, MD, USA, 4-5 Jun 1987)			
1	*See* UCRL-96819	E 1.99: DE87011564	MN -20	12:42753
CONF-870636-	(5. national congress on pressure vessels and piping, San Diego, CA, USA, 28 Jun-2 Jul 1987)			
13	NTIS, PC A02; 3	DE87011441	MN -79	12:40975
14	NTIS, PC A02; 3	DE87011440	MN -79	12:40861

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CONF-870642-	(3. national conference on utility DSM programs: demand-side management strategies in transition, Houston, TX, USA, 16-18 Jun 1987)			
5	*See* PNL-SA-14864	E 1.99: DE87012168	MN -95d	12:41153
CONF-870644-	(78. annual meeting of the American Society of Biological Chemists conference, Philadelphia, PA, USA, 7-11 Jun 1987)			
	Fed. Proc., Fed. Am. Soc. Exp. Biol., 46: No. 6, 2000(1 May 1987)			12:42045
	Fed. Proc., Fed. Am. Soc. Exp. Biol., 46: No. 6, -2052(1 May 1987)			12:42051
CONF-870649-	(American Society for Testing and Materials, Cincinnati, OH, USA, 21-26 Jun 1987)			
1	*See* SAND-87-1864C	E 1.99: DE87012373	MN -71	12:40497
CONF-870656-	(6. Institute of Electrical and Electronic Engineers pulsed power conference, Arlington, VA, USA, 29 Jun-1 Jul 1987)			
3	*See* SAND-87-0056C	DE87010743	MN -28	12:41762
5	*See* SAND-87-0239C	E 1.99: DE87011318	MN -28	12:41763
6	*See* SAND-87-0018C	E 1.99: DE87011310	MN -28	12:41697
7	*See* SAND-87-1698C	DE87011306	MN -38	12:41670
8	*See* SAND-86-2924C	E 1.99: DE87011196	MN -28	12:41664
9	*See* SAND-87-0279C	E 1.99: DE87011286	MN -37	12:41669
10	*See* SAND-87-0110C	E 1.99: DE87011314	MN -28	12:41719
11	*See* SAND-87-0495C	E 1.99: DE87011312	MN -28	12:41764
13	*See* SAND-87-0190C	E 1.99: DE87011720	MN -21	12:42801
14	*See* SAND-87-0613C	E 1.99: DE87011726	MN -21	12:42803
16	*See* SAND-87-1512C	E 1.99: DE87011719	MN -21	12:42804
17	*See* UCRL-96203	E 1.99: DE87011883	MN -38	12:41672
18	*See* SAND-87-0019C	E 1.99: DE87011285	MN -20f	12:42800
21	*See* SAND-87-0423C	DE87011853	MN -21	12:42802
22	*See* LA-UR-87-2138	DE87011741	MN -38	12:41668
24	*See* SAND-87-1657C	DE87011864	MN -21	12:42805
CONF-870677-	(6. IMACS international symposium on computer methods for partial differential equations, Bethlehem, PA, USA, 23-26 Jun 1987)			
8	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011444	MN -32	12:42870
CONF-870679-	(5. symposium on energy engineering sciences, Argonne, IL, USA, 17-19 Jun 1987)			
2	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87010893	MN -38	12:41586
CONF-870682-	(Workshop on novel mechanisms for superconductivity, Berkeley, CA, USA, 22-25 Jun 1987)			
4	*See* SAND-87-1653C	E 1.99: DE87012358	MN -25	12:41366
CONF-870695-	(80. annual meeting of the Air Pollution Control Association, New York, NY, USA, 1 Jun 1987)			
5	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87011119	MN -11	12:41887
8	*See* PNL-SA-14843	E 1.99: DE87012169	MN -11	12:41970
CONF-8706103-	(NATO advanced study institute on alloy phase stability, Crete, Greece, 14-27 Jun 1987)			
4	*See* LBL-23535	E 1.99: DE87012888	MN -25	12:41320
CONF-8706106-	(JOWOG-12, Aldermaston, UK, 29 Jun-3 Jul 1987)			
4	*See* UCRL-96795	E 1.99: DE87011887	MN -45	12:41862
CONF-8706110-	(5. international conference on numerical methods for thermal problems, Montreal, Canada, 29 Jun-3 Jul 1987)			
2	*See* SAND-87-0875C	E 1.99: DE87011094	MN -38	12:41330
CONF-8706111-	(12. annual meeting and international symposium of the Technology Transfer Society, Washington, DC, USA, 22-25 Jun 1987)			
2	*See* UCRL-96830	E 1.99: DE87011886	MN -20	12:42808
3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011663	MN -13	12:41104
CONF-8706113-	(6. Adriatic international conference on nuclear physics, Dubrovnik, Yugoslavia, 15-19 Jun 1987)			
4	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012247	MN -34C	12:42587
CONF-8706125-	(Conference on advances in cryogenic engineering, St. Charles, IL, USA, 14-18 Jun 1987)			
9	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87012256	MN -38	12:41589
CONF-8706128-	(8. international conference on laser spectroscopy, Are, Sweden, 22-26 Jun 1987)			
2	*See* UCRL-96778	E 1.99: DE87011326	MN -34A	12:42363
CONF-8706129-	(Technical Writers Institute meeting, Troy, NY, USA, 9-12 Jun 1987)			
1	*See* LA-UR-87-1408	E 1.99: DE87009009	MN -32	12:42901
CONF-8706130-	(1. IEEE international conference on neural networks, San Diego, CA, USA, 21-24 Jun 1987)			
2	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87011122	MN -38	12:42876
3	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87011121	MN -38	12:42877
CONF-8706134-	(6. ASTM/EURATOM symposium, Jackson Hole, WY, USA, 1-5 Jun 1987)			
1	*See* HEDL-SA-3533	E 1.99: DE87010712	MN -78	12:40831
CONF-8706148-	(Actinide in-vivo measurement workshop, Cromwell, CT, USA, 3-5 Jun 1987)			
1	*See* MLM-3437(OP)	E 1.99: DE87011839	MN -48	12:42238

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CONF-8706149-	(International conference on the theory of few body and quark-hadronic systems, Dubna, USSR, 16-20 Jun 1987)			
1	*See* LA-UR-87-2037	E 1.99: DE87011770	MN -34C	12:42607
CONF-8706152-	(European Materials Research Society conference, Strasbourg, France, 2-5 Jun 1987)			
2	*See* SLAC-PUB-4309	E 1.99: DE87012836	MN -34B	12:41850
CONF-8706153-	(Emerging nuclear suppliers and nonproliferation conference, Bellagio, Italy, 22-26 Jun 1987)			
1	*See* UCRL-96797	E 1.99: DE87011554	MN -2	12:41277
CONF-8706155-	(6. IEEE pulsed power conference, Washington, DC, USA, 29 Jun-1 Jul 1987)			
1	*See* LA-UR-87-2101	DE87011761	MN -38	12:41667
CONF-8706159-	(2. international conference on the structure of surfaces, Amsterdam, Netherlands, 22-25 Jun 1987)			
1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87011650	MN -4	12:41293
2	*See* LBL-23537	E 1.99: DE87012891	MN -25	12:41321
3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011670	MN -25	12:41294
CONF-8706162-	(11. annual geothermal conference and workshop, Oakland, CA, USA, 22-29 Jun 1987)			
1	*See* SAND-87-1573C	E 1.99: DE87012104	MN -66a	12:40732
CONF-8706164-	(Symposium of biological transport group and midwest salt and water club joint meeting, Cumberland, KY, USA, 21-24 Jun 1987)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012526	MN -48	12:42043
CONF-8706165-	(Parachute systems technology: fundamentals, concepts, and applications, Munich, F.R. Germany, 22-26 Jun 1987)			
1	*See* SAND-87-1648C	DE87011634	MN -38	12:41607
2	*See* SAND-87-1649C	E 1.99: DE87011722	MN -38	12:41608
CONF-8706172-	(24. annual American Society for Hospital Engineering conference, San Diego, CA, USA, 1-5 Jun 1987)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011438	MN -41	12:42260
CONF-8706175-	(Expert systems conference, Dearborn, MI, USA, 9-11 Jun 1987)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011674	MN -13	12:42864
CONF-870701-	(8. international congress of radiation research, Edinburgh, UK, 19-24 Jul 1987)			
3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012529	MN -48	12:42190
4	*See* DOE/ER/00038-3013	E 1.99: DE87012749	MN -4	12:41550
5	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012531	MN -41	12:41972
6	*See* BNL-40037	E 1.99: DE87012871	MN -4	12:41497
CONF-870705-	(Annual meeting of the Health Physics Society, Salt Lake City, UT, USA, 5-9 Jul 1987)			
2	*See* PNL-SA-14915	E 1.99: DE87012162	MN -41	12:42247
CONF-870706-	(Summer computer simulation conference, Montreal, Canada, 27-29 Jul 1987)			
2	*See* EGG-M-36886	E 1.99: DE87012433	MN -80	12:40888
CONF-870713-	(28. INMM annual meeting on safeguards: a mature technology, Newport Beach, CA, USA, 12-15 Jul 1987)			
32	*See* DP-MS-87-48	E 1.99: DE87012382	MN -16	12:40661
33-Rev.1	*See* UCRL-96016-Rev.1	DE87012627	MN -15	12:41437
34	*See* LA-UR-87-2293	DE87013145	MN -15	12:41434
35	*See* LA-UR-87-2295	DE87013146	MN -15	12:40666
36	*See* SAND-87-1174C	DE87012733	MN -71	12:40496
37	*See* LA-UR-87-2349	E 1.99: DE87013155	MN -15	12:40667
38	*See* K/CSD/INF-87-13	E 1.99: DE87012680	MN -16	12:40665
40	*See* BNL-40051	DE87013303	MN -13	12:42861
CONF-870725-	(22. annual meeting of the Microbeam Analysis Society, Kailua-Kona, HI, USA, 13-17 Jul 1987)			
9	*See* BNL-40040	DE87012869	MN -25	12:41357
CONF-870728-	(Unconventional gas recovery and utilization, Morgantown, WV, USA, 28-31 Jul 1987)			
1	*See* SAND-87-1543C	E 1.99: DE87012398	MN -132	12:40462
2	*See* SAND-87-1541C	E 1.99: DE87012396	MN -132	12:40461
3	*See* SAND-87-1544C	E 1.99: DE87012397	MN -132	12:40463
4	*See* SAND-87-1542C	E 1.99: DE87012395	MN -132	12:40460
5	*See* SAND-87-1612C	E 1.99: DE87012722	MN -132	12:40466
6	*See* SAND-87-1652C	E 1.99: DE87013065	MN -132	12:42307
CONF-870733-	(Pacific workshop and meeting on analytical electron microscopy, Kona, HI, USA, 12-17 Jul 1987)			
7	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012522	MN -25	12:41290
CONF-870737-	(16. shock tube symposium, Aachen, F.R. Germany, 26-30 Jul 1987)			
2	*See* UCRL-96960	E 1.99: DE87013498	MN -35	12:41871
CONF-870742-	(10. IFAC world congress on automatic control, Munich, F.R. Germany, 27-31 Jul 1987)			
2	NTIS, PC A02; 3	DE87011171	MN -38	12:41578
CONF-870753-	(5. topical conference of the American Physical Society on shockwaves in condensed matter, Monterey, CA, USA, 20-23 Jul 1987)			
5	*See* UCRL-96386	E 1.99: DE87011888	MN -34	12:41336
26	*See* SAND-87-0850C	E 1.99: DE87012371	MN -38	12:41580

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28	*See* SAND-87-0677C	E 1.99: DE87012734	MN -25	12:41326
31	*See* SAND-87-0973C	DE87012405	MN -25	12:41849
38	*See* SAND-87-0774C	DE87011063	MN -25	12:41327
39	*See* SAND-87-0830C	E 1.99: DE87012729	MN -25	12:41329
40	*See* SAND-87-0917C	DE87012719	MN -25	12:41397
41	*See* SAND-87-1871C	E 1.99: DE87012979	MN -25	12:41332
42	*See* SAND-87-0886C	E 1.99: DE87012978	MN -25	12:41331
43	*See* SAND-87-0648C	E 1.99: DE87012972	MN -25	12:41325
45	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012926	MN -25	12:41291
47	*See* LA-UR-87-2292	E 1.99: DE87013144	MN -45	12:41857
48	*See* LA-UR-87-2284	E 1.99: DE87013142	MN -25	12:41317
54	*See* LA-UR-87-2466	E 1.99: DE87013166	MN -45	12:41858
55	*See* UCRL-96507	E 1.99: DE87013104	MN -45	12:41860
CONF-870757-	(IEEE Power Engineering Society summer meeting, San Francisco, CA, USA, 12-17 Jul 1987)			
4	*See* SAND-87-1123C	DE87011633	MN -63	12:40719
CONF-870761-	(3. international conference on modulated semiconductor structure, Montpelier, France, 6-10 Jul 1987)			
2	*See* DOE/ER/45297-3	E 1.99: DE87012726	MN -25	12:41295
CONF-870765-	(14. annual conference on plasma physics, St. Andrew, UK, 1-3 Jul 1987)			
1	*See* UCRL-96774	E 1.99: DE87011324	MN -20a	12:42807
CONF-870779-	(3. workshop on heavy charged particles in biology and medicine, Darmstadt, F.R. Germany, 13-15 Jul 1987)			
2	*See* DOE/ER/00038-2992	E 1.99: DE87012748	MN -4	12:41548
CONF-870781-	(Conference on the liquid state and its electrical properties, Sintra, Portugal, 5-17 Jul 1987)			
1	*See* BNL-40026	E 1.99: DE87012487	MN -4	12:41496
CONF-870782-	(Workshop on separation phenomena in liquids and gases, Darmstadt, F.R. Germany, 20-23 Jul 1987)			
1	*See* K/ITP-131	E 1.99: DE87011702	MN -22	12:40675
CONF-870783-	(Radiation effects in insulators-4 conference, Lyon, France, 6-10 Jul 1987)			
1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87012290	MN -25	12:41380
2	*See* SAND-87-0911C	E 1.99: DE87012973	MN -25	12:41396
3	*See* SAND-87-0910C	E 1.99: DE87013523	MN -25	12:41395
CONF-870786-	(International conference on liquid crystal polymers, Bordeaux, France, 20-24 Jul 1987)			
1	*See* LA-UR-87-2337	E 1.99: DE87013154	MN -25	12:41393
CONF-870793-	(Conference on interface science and engineering, Lake Placid, NY, USA, 12-17 Jul 1987)			
1	*See* LA-UR-87-2366	E 1.99: DE87013156	MN -25	12:41318
CONF-870801-	(International conference on nuclear fuel reprocessing and waste management, Paris, France, 24-28 Aug 1987)			
2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011934	MN -79c	12:40487
3	*See* DP-MS-86-197	E 1.99: DE87012944	MN -83	12:40503
CONF-870804-	(22. intersociety energy conversion engineering conference, Philadelphia, PA, USA, 10-14 Aug 1987)			
19	*See* UCRL-95973	DE87011549	MN -77	12:40885
CONF-870811-	(Energy conservation program evaluation: practical methods and useful results, Chicago, IL, USA, 19-21 Aug 1987)			
3	NTIS, PC A02; 3	DE87011184	MN -95d	12:41140
4	NTIS, PC A02/MF A01; 1	DE87012250	MN -95d	12:41141
CONF-870812-	(9. SMIRT: international conference on structural mechanics in reactor technology, Lausanne, Switzerland, 17-21 Aug 1987)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87005714	MN -78	12:40912
2	*See* UCRL-96072	E 1.99: DE87005838	MN -78	12:41078
3	*See* SAND-86-1605C	E 1.99: DE87005874	MN -78	12:41072
5	*See* SAND-86-1656C	E 1.99: DE87006125	MN -78	12:41073
8	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87007371	MN -20b	12:42773
13	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011400	MN -79	12:40976
14	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87011398	MN -78	12:40950
15	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011401	MN -79	12:40977
16	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011472	MN -80	12:40913
17	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011461	MN -20c	12:42774
18	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011470	MN -79	12:40978
19	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011474	MN -80	12:40979
21	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011058	MN -80	12:40914
26	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011468	MN -79	12:40980
27	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011466	MN -80	12:40981
28	*See* EGG-M-17686	E 1.99: DE87012431	MN -80	12:40917
CONF-870816-	(24. national heat transfer conference and exhibition, Pittsburgh, PA, USA, 9-12 Aug 1987)			
2	*See* LA-UR-87-118	E 1.99: DE87005108	MN -78	12:41029
3	*See* LA-UR-87-167	E 1.99: DE87005102	MN -78	12:41030
4	*See* LA-UR-87-117	E 1.99: DE87005109	MN -78	12:41647
5	*See* LA-UR-87-116	E 1.99: DE87005110	MN -78	12:41028
6	*See* SAND-87-0095C	E 1.99: DE87005853	MN -38	12:41574
7	*See* SAND-86-0867C	E 1.99: DE87005882	MN -80	12:41071
13	*See* SAND-86-2508C	E 1.99: DE87007847	MN -80	12:41074

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14	*See* LA-UR-87-1412	E 1.99:	DE87009010	MN -78	12:41031
15	*See* EGG-M-35386		DE87009401	MN -78	12:40989
16-Rev.1	*See* EGG-M-00787-Rev.1	E 1.99:	DE87009756	MN -80	12:40869
21	NTIS, PC A02; 3		DE87011406	MN -78	12:40982
26	NTIS, PC A02; 3		DE87011384	MN -80	12:40816
27	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011407	MN -78	12:40983
CONF-870820-	(PSA 87: international topical meeting on probabilistic safety assessment and risk management, Zurich, Switzerland, 31 Aug-4 Sep 1987)				
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87004949	MN -79p	12:40984
5	*See* BNL-NUREG-39975	E 1.99:	DE87012873	MN -78	12:40965
6	*See* SAND-86-2838C	E 1.99:	DE87012980	MN -78	12:41076
CONF-870822-	(American Institute of Chemical Engineers summer national meeting, Minneapolis, MN, USA, 16-19 Aug 1987)				
3	*See* SERI/TP-231-3194	E 1.99:	DE87001199	MN -61	12:40690
4	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012543	MN -2	12:40479
CONF-870830-	(AIAA aerodynamics flight mechanics conference, Monterey, CA, USA, 17-19 Aug 1987)				
1	*See* SAND-86-0487C	E 1.99:	DE87004519	MN -38	12:41603
3	*See* SAND-86-2923C	E 1.99:	DE87004241	MN -38	12:41604
5	*See* SAND-87-0031C	E 1.99:	DE87005061	MN -38	12:41605
6	*See* SAND-87-0063C		DE87010476	MN -38	12:41651
CONF-870839-	(3. international symposium on environmental degradation of materials in nuclear power systems: water reactors, Traverse City, MI, USA, 30 Aug-3 Sep 1987)				
1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011395	MN -80	12:41543
CONF-870855-	(20. international cosmic ray conference, Moscow, USSR, 2-15 Aug 1987)				
3	*See* ANL-HEP-CP-87-37	E 1.99:	DE87011382	MN -34B	12:42311
CONF-870863-	(Seminar on small and medium-sized nuclear reactors: safety and licensing issues, Lausanne, Switzerland, 24-26 Aug 1987)				
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87008597	MN -80	12:40887
CONF-870864-	(4. American Meteorological Society's conference on mountain meteorology, Seattle, WA, USA, 25-28 Aug 1987)				
1	*See* LA-UR-87-1464	E 1.99:	DE87009014	MN -11	12:41874
2	*See* LA-UR-87-1471	E 1.99:	DE87009015	MN -11	12:41875
3	*See* LA-UR-87-1678	E 1.99:	DE87010122	MN -11	12:41890
4	*See* LA-UR-87-1704	E 1.99:	DE87010123	MN -11	12:41876
5	*See* LA-UR-87-1745	E 1.99:	DE87010130	MN -11	12:41877
6	*See* LA-UR-87-1657		DE87010120	MN -11	12:41889
CONF-870894-	(American Society of Civil Engineers engineering hydrology symposium, Williamsburg, VA, USA, 3-7 Aug 1987)				
2	*See* LBL-23370	E 1.99:	DE87011225	MN -70	12:40542
CONF-870896-	(Workshop on languages for automation, Vienna, Austria, 24-27 Aug 1987)				
1	*See* SAND-87-1511C		DE87011316	MN -38	12:41606
CONF-870898-	(Joint statistical meeting, San Francisco, CA, USA, 16-20 Aug 1987)				
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011115	MN -32	12:42871
CONF-870899-	(4. symposium on logic programming, San Francisco, CA, USA, 31 Aug-4 Sep 1987)				
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011467	MN -32	12:42872
CONF-8708100-	(International conference on luminescence, Beijing, China, 17-21 Aug 1987)				
2	*See* UCRL-96160	E 1.99:	DE87011924	MN -25	12:41400
CONF-8708101-	(6. international symposium on capture gamma-ray spectroscopy, Leuven, Belgium, 31 Aug-4 Sep 1987)				
1	*See* BNL-39978	E 1.99:	DE87012492	MN -34C	12:42584
CONF-8708102-	(Pion nucleus physics: future directions and new facilities at LAMPF workshop, Los Alamos, NM, USA, 17-21 Aug 1987)				
1	*See* LA-UR-87-2036	E 1.99:	DE87011771	MN -34C	12:42516
CONF-8708104-	(Conference on solid state amorphizing transformation, Los Alamos, NM, USA, 10-13 Aug 1987)				
1	*See* SAND-87-0817C	E 1.99:	DE87012718	MN -25	12:41328
CONF-8708105-	(34. IUPAC General Assembly, Boston, MA, USA, 21-29 Aug 1987)				
1	*See* BNL-NCS-39952		DE87012865	MN -4	12:42897
CONF-8708106-	(13. annual underground coal gasification symposium, Laramie, WY, USA, 24-26 Aug 1987)				
1	*See* UCRL-96462	E 1.99:	DE87013222	MN -109	12:40358
CONF-870901-	(10. international conference on magnet technology (MT-10), Boston, MA, USA, 21-26 Sep 1987)				
1	*See* SLAC-PUB-4028	E 1.99:	DE87008330	MN -28	12:41766
CONF-870902-	(ICBEM '87: international congress on building energy management, Lausanne, Switzerland, 28 Sep-2 Oct 1987)				
1	*See* LBL-22908	E 1.99:	DE87006947	MN -95d	12:41150

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CONF-870913-	(Annual technical conference and exhibition of the Society of Petroleum Engineers, Dallas, TX, USA, 27-30 Sep 1987)				
1	*See* SAND-87-1675C		TI87012731	ND -132	12:40464
CONF-870914-	(10. world energy engineering congress, Atlanta, GA, USA, 29 Sep-2 Oct 1987)				
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87009828	MN -38	12:41587
CONF-870917-	(ANS/ENS international conference on fast breeder reactor systems: experience gained and path to economical power generation, Richland, WA, USA, 13-17 Sep 1987)				
1	NTIS, PC A02; 3		DE87010589	MN -79	12:40873
2	NTIS, PC A02; 3		DE87010598	MN -79	12:40874
CONF-870937-	(6. international conference on heavy metals in the environment, New Orleans, LA, USA, 15-18 Sep 1987)				
2	NTIS, PC A02; 3		DE87010380	MN -11	12:42009
3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87010907	MN -11	12:42010
CONF-870946-	(5. international congress on polymers in concrete, Brighton, UK, 21-24 Sep 1987)				
2	*See* BNL-38945	E 1.99:	DE87005239	MN -66d	12:40739
CONF-870950-	(14. annual national American Society for Quality Control, Las Vegas, NV, USA, 14-16 Sep 1987)				
1	*See* DP-MS-87-59	E 1.99:	DE87012389	MN -13	12:42863
CONF-870961-	(4. symposium on containment of underground nuclear explosions, Colorado Springs, CO, USA, 21-24 Sep 1987)				
1	*See* SAND-87-0372C	E 1.99:	DE87012730	MN -45	12:41870
CONF-870985-	(National thermal spray conference, Orlando, FL, USA, 14-17 Sep 1987)				
1	*See* SAND-87-0006C	E 1.99:	DE87010686	MN -38	12:41579
CONF-870987-	(IEEE international workshop on control systems in new energy applications, Madrid, Spain, 28-29 Sep 1987)				
1	*See* SAND-87-0147C	E 1.99:	DE87010495	MN -63	12:40700
CONF-870989-	(6. symposium on turbulent shear flow, Toulouse, France, 7-9 Sep 1987)				
1	*See* LBL-23521		DE87011099	MN -38	12:41648
CONF-8709107-	(American Society of Mechanical Engineers vibration conference, Boston, MA, USA, 27-30 Sep 1987)				
1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011404	MN -38	12:41642
CONF-8709109-	(5. US Army symposium on gun dynamics, Rensselaerville, NY, USA, 23-25 Sep 1987)				
1	*See* LA-UR-87-2251	E 1.99:	DE87011727	MN -38	12:41598
CONF-8709111-	(4. annual symposium on improving building energy efficiency in hot and humid climates, Houston, TX, USA, 15-16 Sep 1987)				
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012539	MN -95d	12:41142
CONF-8709112-	(Joint symposium on composite materials science and engineering, Newark, DE, USA, 23-25 Sep 1987)				
1	*See* K/ETAC-5	E 1.99:	DE87012036	MN -25	12:41391
CONF-8709113-	(Faraday discussion on dynamics of elementary gas phase reactions, Birmingham, UK, 14-16 Sep 1987)				
2	*See* LBL-23701	E 1.99:	DE87012894	MN -4	12:41501
COO-					
1195-505	*See* DOE/ER/01195-505	E 1.99:	DE87013422	MN -34D	12:42419
1599-308-Pt.1	*See* DOE/ER/60515-1-Pt.1	E 1.99:	DE87012142	MN -48	12:41997
1599-308-Pt.3	*See* DOE/ER/60515-T1-Pt.3		TI87012143	ND -61C	12:41998
1599-308-Pt.4	*See* DOE/ER/60515-T1-Pt.4	E 1.99:	DE87012144	MN -48	12:41999
4326-7	*See* DOE/EV/04326-7	E 1.99:	DE87013018	MN -48	12:42193
CRN-HE-					
85-04	NTIS (US Sales Only), PC A08/MF A01		DE87751824	MN -34D	12:42417
CRN-PN-					
86-02	NTIS (US Sales Only), PC A08/MF A01		DE87752281	MN -34D	12:42445
86-03	NTIS (US Sales Only), PC A05/MF A01		DE87751819	MN -34C	12:42512
CSIR-SWISK-					
41	*See* PB-87-188975/XAB				12:41111
CTA-IEAV-NT-					
02/ 85	NTIS (US Sales Only), PC A02/MF A01		DE87702669	MN -34C	12:42520
DESY-					
85-019	NTIS PC E07; Available from NTIS as TIB/B87-07331			ND -34D	12:42418
DHHS/PUB/NIOSH-					
87-102	*See* PB-87-184214/XAB				12:41600
DOE/BP-					
653	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87001327	MN -60	12:40744
833	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87013419	MN -95	12:41143
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T1	NTIS, PC A09; 3		DE87011168	MN -95f	12:41245
DOE/BP/31011-					
1	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011894	MN -95d	12:41144
DOE/CE-					
0184	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011085	MN -95f	12:41246

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DOE/CE/30742-				
17	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99: DE87013396	MN -59B	12:40722
18	NTIS, PC A07; 3	DE87013397	MN -59B	12:40723
DOE/CE/40606-				
T4	NTIS, PC A09/MF A01; 1 (GPO Dep.)	E 1.99: DE87013555	STD -95f	12:41247
DOE/CE/40747-				
T1	NTIS, PC A18/MF A01; 1 (GPO Dep.)	E 1.99: DE87012003	STD -95f	12:41248
DOE/CE/63490-				
T5	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99: DE87013405	MN -95d	12:41145
DOE/CH-				
10140-05-87	NTIS, PC A15/MF A01; 1 (GPO Dep.)	E 1.99: DE87012850	STD -70	12:40500
DOE/EIA-				
0121(87/ 1Q)	NTIS, PC A07/MF A01 - GPO; 1 (GPO Dep.)	E 1.99: DE87012956	MN -98A	12:40414
0205(87/ 2)	NTIS, PC A05/MF A01 - GPO; 1 (GPO Dep.)	E 1.99: DE87013214	MN -13	12:42862
0397(87/ 1Q)	NTIS, PC A15/MF A01 - GPO; 1 (GPO Dep.)	E 1.99: DE87013433	MN -98E	12:41117
0455(85)	NTIS, PC A12/MF A01 - GPO; 1 (GPO Dep.)	E 1.99: DE87011017	MN -98	12:41118
DOE/ER-				
0331	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87012029	MN -11	12:41973
0332	NTIS, PC A14/MF A01; 1 (GPO Dep.)	E 1.99: DE87013578	STD -41	12:41928
DOE/ER/00038-				
2992	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012748	MN -4	12:41548
3009	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87013390	MN -4	12:41549
3013	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012749	MN -4	12:41550
DOE/ER/01195-				
505	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99: DE87013422	MN -34D	12:42419
DOE/ER/03274-				
8	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012457	MN -34D	12:42695
DOE/ER/04054-				
10	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87010882	MN -38	12:41643
DOE/ER/10497-				
T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011011	MN -34A	12:42380
DOE/ER/10645-				
21	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013395	MN -95f	12:41249
DOE/ER/12086-				
T3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012651	MN -48	12:42044
DOE/ER/13273-				
T1	NTIS, PC A02; 3	DE87013191	MN -48	12:42178
DOE/ER/13405-				
T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012072	MN -34A	12:42352
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2	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99: DE87011192	MN -11	12:42295
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7	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010652	MN -21	12:42716
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1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013193	MN -48	12:40695
DOE/ER/13579-				
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013073	MN -4	12:41498
DOE/ER/13626-				
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012470	MN -25	12:41279
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4	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87011830	MN -38	12:41619
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6	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87010819	MN -32	12:42878
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4	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87012469	MN -34D	12:42446
11	NTIS, PC A02; 3	DE87008660	MN -28	12:41687
14	NTIS, PC A02; 3	DE87008661	MN -28	12:41688
20	NTIS, PC A02; 3	DE87008663	MN -28	12:41740
21	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87008669	MN -28	12:41689
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T7	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013194	MN -34D	12:42420
DOE/ER/40233-				
2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012206	MN -34D	12:42493
DOE/ER/40286-				
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87009656	MN -34C	12:42588
DOE/ER/40315-				
142	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE87012752	MN -34C	12:42510
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17	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87012742	MN -25	12:41590
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T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013392	MN -25	12:41381
DOE/ER/45112-				
4	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99: DE87011708	MN -38	12:41660
DOE/ER/45161-				
3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012823	MN -25	12:41382
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T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012994	MN -4	12:41129
DOE/ER/45224-				
3	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87012862	MN -25	12:41383
DOE/ER/45297-				
3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012726	MN -25	12:41295
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DOE/ER/53193-7	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99:	DE87012232	MN -20	12:42717
DOE/ER/53212-108	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87012045	MN -20g	12:42718
DOE/ER/60197-10	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012647	MN -11	12:42011
DOE/ER/60203-T2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013689	MN -48	12:42064
DOE/ER/60515-1-Pt.1	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012142	MN -48	12:41997
T1-Pt.3	Dept. of Botany & Pathology, Univ. of Mich., Ann Arbor, MI 48109		TI87012143	ND -61C	12:41998
T1-Pt.4	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012144	MN -48	12:41999
DOE/EV/02031-17	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013088	MN -48	12:42065
DOE/EV/02217-58	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013685	MN -48	12:42192
DOE/EV/02270-15	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012751	MN -48	12:41947
DOE/EV/04326-7	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013018	MN -48	12:42193
DOE/FC/10627-2274	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87006034	MN -106	12:40350
DOE/FE-0090	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013416	MN -101	12:41116
DOE/FE/05081-2198	NTIS, PC A13; 3 (GPO Dep.)	E 1.99:	DE87001010	STD -109	12:40324
DOE/FE/60177-2389	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013439	STD -123	12:40478
2390	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013437	STD -123	12:40477
2392	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013750	STD -109	12:40325
2393	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013448	STD -109	12:40326
2394	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013744	STD -123	12:40471
2395	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013781	STD -123	12:40473
DOE/ID/12526-T1	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013078	MN -66b	12:40733
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DOE/ID/12626-T1	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012714	STD -95f	12:41358
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0243	USDOE-TIC, PO Bx 62, Oak Ridge, TN 37830		TI87013780	STD -13	12:40736
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2240	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87003415	MN -102	12:40329
DOE/MC/21313-2222	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87003859	MN -106	12:40351
DOE/MC/21353-2372	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87006499	MN -103	12:41644
2373	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87006500	MN -103	12:40404
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DOE/NE/37959-4	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011870	MN -80	12:40934
5	NTIS, PC A03; 3		DE87011871	MN -80	12:40951
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DOE/OR/00033-T321	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012454	MN -71	12:40493
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DOE/PC/70764-7	NTIS, PC A12/MF A01; 1 (GPO Dep.)	E 1.99:	DE87010575	STD -102	12:40352
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T8	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE87011043	STD -103	12:40405
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DOE/PC/90962-				
T3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012691	MN -104	12:40406
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25	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99: DE87001255	STD -122	12:40428
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0015	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87004496	MN -80	12:40988
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87-2	*See* AD-A-179731/5/XAB			12:40432
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1742	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87012849	STD -70	12:40502
1748	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012848	STD -38	12:41297
1750	NTIS, PC A16/MF A01; 1 (GPO Dep.)	E 1.99: DE87013054	MN -38	12:41591
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86-197	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012944	MN -83	12:40503
86-214	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012942	MN -11	12:41929
86-219	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87011241	MN -80	12:40916
87-16	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87011238	MN -38	12:40504
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87-59	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012389	MN -13	12:42863
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85-713	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87013037	MN -11	12:41960
86-133-4/ 87-3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013284	MN -23	12:40680
86-298	NTIS, PC A13; 3	DE87013043	MN -41	12:41974
86-710	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87013046	MN -41	12:41888
86-795	NTIS, PC A15/MF A01; 1 (GPO Dep.)	E 1.99: DE87013033	MN -11	12:42031
86-798	NTIS, PC A10/MF A01; 1 (GPO Dep.)	E 1.99: DE87012941	MN -11	12:42028
86-799	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99: DE87012945	MN -11	12:42029
86-800	NTIS, PC A14/MF A01; 1 (GPO Dep.)	E 1.99: DE87013032	MN -11	12:42032
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27	*See* DPST-86-798	E 1.99: DE87012941	MN -11	12:42028
28	*See* DPST-86-799	E 1.99: DE87012945	MN -11	12:42029
29	*See* DPST-86-800	E 1.99: DE87013032	MN -11	12:42032
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798(25) -85	NTIS (US Sales Only), PC A02/MF A01	DE87702673	MN -37	12:41790
805(32) -85	NTIS (US Sales Only), PC A02/MF A01	DE87702674	MN -34B	12:42314
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826(53) -85	NTIS (US Sales Only), PC A02/MF A01	DE87702677	MN -34A	12:41384
827(54) -85	NTIS (US Sales Only), PC A03/MF A01	DE87702678	MN -34C	12:42627
828(55) -85	NTIS (US Sales Only), PC A02/MF A01	DE87702679	MN -34A	12:42640
829(56) -85	NTIS (US Sales Only), PC A03/MF A01	DE87702680	MN -34D	12:42447
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831(58) -85	NTIS (US Sales Only), PC A02/MF A01	DE87702682	MN -34A	12:42641
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835(62) -85	NTIS (US Sales Only), PC A03/MF A01	DE87702686	MN -34D	12:42450
836(63) -85	NTIS (US Sales Only), PC A03/MF A01	DE87702687	MN -34D	12:42699
837(64) -85	NTIS (US Sales Only), PC A02/MF A01	DE87702688	MN -34C	12:42589
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842(69) -85	NTIS (US Sales Only), PC A02/MF A01	DE87702693	MN -34D	12:42495
843(70) -85	NTIS (US Sales Only), PC A02/MF A01	DE87702694	MN -34D	12:42452
844(71) -85	NTIS (US Sales Only), PC A02/MF A01	DE87702695	MN -34D	12:42453
846(73) -85	NTIS (US Sales Only), PC A03/MF A01	DE87702696	MN -34D	12:42496
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848(75) -85	NTIS (US Sales Only), PC A03/MF A01	DE87702698	MN -20	12:42776
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851(2) -86	NTIS (US Sales Only), PC A02/MF A01	DE87702700	MN -34D	12:42455
854(5) -86	NTIS (US Sales Only), PC A02/MF A01	DE87702701	MN -34D	12:42456
855(6) -86	NTIS (US Sales Only), PC A02/MF A01	DE87702702	MN -34D	12:42457
856(7) -86	NTIS (US Sales Only), PC A04/MF A01	DE87702703	MN -32	12:42879
861(12) -86	NTIS (US Sales Only), PC A02/MF A01	DE87702704	MN -28	12:41710
862(13) -86	NTIS (US Sales Only), PC A02/MF A01	DE87702705	MN -34A	12:41385
865(16) -86	NTIS (US Sales Only), PC A02/MF A01	DE87702706	MN -34D	12:42701
EGG-				
2421	*See* NUREG/CR-4407	TI87012379	MN -78	12:41044
2440	*See* NUREG/CR-4531	TI87007047	MN -80	12:41045
2462	*See* NUREG/CR-4925	TI87011023	MN -78	12:41069
2511	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87012847	STD -66a	12:40737
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36886	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012433	MN -80	12:40888
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617	NTIS (US Sales Only), PC A03/MF A01	DE87702559	MN -25	12:41299
620	NTIS (US Sales Only), PC A03/MF A01	DE87702560	MN -4	12:41551
EPA-				
450/ 3-85/ 001A	*See* PB-87-190336/XAB			12:40441
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5045	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920528	ND -108	12:40338
5134-Vol.2	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920522	ND -66	12:40738
5219	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920504	ND -60	12:40746
5229	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920523	ND -63	12:40718
5301	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920526	ND -94e	12:41082
5324	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920527	ND -94c	12:40771
5340	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920547	ND -109	12:40339
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5186	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920515	ND -103	12:40407
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5052	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920284	ND -80	12:40814
5358	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920548	ND -41	12:42261
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5258	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920499	ND -97	12:40811

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5262	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920535	ND -97	12:40812
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5297-SR	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920529	ND -95f	12:41119
5298-SR	Reserach Reports Center, Box 50490, Palo Alto, CA 94303	TI87920530	ND -95f	12:41120
5300	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920534	ND -95d	12:41146
5308	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920476	ND -97b	12:41121
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4534	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920329	ND -80	12:41000
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4902-SR	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920519	ND -78	12:40828
4997	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920302	ND -80	12:40918
5017	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920303	ND -80	12:40919
5120	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920498	ND -78	12:40920
5129	NTIS, PC A09/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303; 1 (GPO Dep.)	E 1.99: DE87012820	MN -80	12:41300
5131	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920487	ND -78	12:40849
5182	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920477	ND -80	12:40921
5193	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920468	ND -80	12:40829
5199-Vol.1	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920469	ND -78	12:40850
5246	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920484	ND -78	12:40830
5248	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920488	ND -78	12:40851
5249-Vol.1	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920508	ND -80	12:40852
5249-Vol.2	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920509	ND -78	12:40853
5250M	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920483	ND -78	12:41002
5254	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920518	ND -80	12:41003
5266	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920501	ND -78	12:40854
5267-Vol.1	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920521	ND -78	12:40855
5267-Vol.2	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920520	ND -78	12:40856
5268	NTIS, PC A11/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303; 1 (GPO Dep.)	E 1.99: DE87012614	STD -85	12:40494
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5233-CCM	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920532	ND -97	12:41122
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ETEC-				
87-5	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87013694	MN -59A	12:40728
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9161	NTIS (US Sales Only), PC A05/MF A01; 1	DE87752538	MN -25	12:41301
9860	NTIS (US Sales Only), PC A17/MF A01; 1	DE87752554	MN -131	12:40469
9934	NTIS (US Sales Only), PC A06/MF A01; 1	DE87752553	MN -4	12:40681
9944	NTIS (US Sales Only), PC A04/MF A01; 1	DE87752536	MN -63	12:40696
10151	NTIS (US Sales Only), PC A04/MF A01; 1	DE87752537	MN -95d	12:41148
10184-Vol.1	NTIS (US Sales Only), PC A09/MF A01	DE87752285	MN -80	12:41004
10184-Vol.2	NTIS (US Sales Only), PC A05/MF A01	DE87752295	MN -80	12:41005
10345	NTIS (US Sales Only), PC A03/MF A01	DE87752294	MN -80	12:40929
10384	NTIS (US Sales Only), PC A03/MF A01	DE87752265	MN -70	12:40505
10392	NTIS (US Sales Only), PC A05/MF A01	DE87752266	MN -70	12:40506
10420	NTIS (US Sales Only), PC A02/MF A01	DE87752296	MN -79	12:41006
10429	NTIS (US Sales Only), PC A04/MF A01	DE87752297	MN -79	12:41007
10516	NTIS (US Sales Only), PC A05/MF A01	DE87752267	MN -70	12:40507
10519	NTIS (US Sales Only), PC A07/MF A01	DE87752286	MN -80	12:41008
10522	NTIS (US Sales Only), PC A03/MF A01	DE87752268	MN -70	12:41302
10579	NTIS (US Sales Only), PC A13/MF A01	DE87752269	MN -70	12:40508
10584	NTIS (US Sales Only), PC A04/MF A01	DE87752287	MN -80	12:41009
10586	NTIS (US Sales Only), PC A04/MF A01	DE87752288	MN -79	12:41010

Report Number	*Availability Source*	*File Number*	*Distribution Category*	*Abstract Number*
10587	NTIS (US Sales Only), PC A03/MF A01	DE87752270	MN -70	12:40509
10589-Vol.1	NTIS (US Sales Only), PC A07/MF A01	DE87752262	MN -70	12:40510
10589-Vol.2	NTIS (US Sales Only), PC A06/MF A01	DE87752263	MN -70	12:40511
10592	NTIS (US Sales Only), PC A07/MF A01	DE87752289	MN -79	12:40922
10619	NTIS (US Sales Only), PC A03/MF A01	DE87752271	MN -70	12:40512
10629	NTIS (US Sales Only), PC A08/MF A01	DE87752290	MN -80	12:42880
10643	NTIS (US Sales Only), PC A07/MF A01	DE87752291	MN -80	12:41011
10693-DE	Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities		ND -94ce	12:41084
10702	NTIS (US Sales Only), PC A04/MF A01	DE87752272	MN -70	12:40513
10703	NTIS (US Sales Only), PC A04/MF A01	DE87752273	MN -70	12:40514
10707	NTIS (US Sales Only), PC A14/MF A01	DE87752292	MN -80	12:41012
10740	NTIS (US Sales Only), PC A07/MF A01	DE87752293	MN -80	12:41013
10868-EN	Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities		ND -95	12:41110
EUR-CEA-FC-				
1306	NTIS (US Sales Only), PC A04/MF A01	DE87751839	MN -20	12:42777
FEI-				
1662	NTIS (US Sales Only), PC A02/MF A01	DE87702707	MN -80	12:40923
1664	NTIS (US Sales Only), PC A02/MF A01	DE87702708	MN -80	12:40875
1671	NTIS (US Sales Only), PC A02/MF A01	DE87702709	MN -38	12:40902
1696	NTIS (US Sales Only), PC A02/MF A01	DE87702710	MN -80	12:40903
1704	NTIS (US Sales Only), PC A02/MF A01	DE87702711	MN -79	12:40876
1706	NTIS (US Sales Only), PC A02/MF A01	DE87702712	MN -38	12:40941
1707	NTIS (US Sales Only), PC A03/MF A01	DE87702713	MN -80	12:40877
1715	NTIS (US Sales Only), PC A02/MF A01	DE87702714	MN -2	12:42899
1779	NTIS (US Sales Only), PC A02/MF A01	DE87702715	MN -34C	12:42590
FMPC-				
2082	NTIS, PC A10/MF A01; 1 (GPO Dep.)	E 1.99: DE87010205	MN -11	12:40609
FNAL/C-				
87/ 62	NTIS, PC A02; 3	DE87009436	MN -37	12:41742
87/ 83	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011069	MN -34D	12:42421
FNAL-TM-				
1452	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87010298	STD -28	12:41743
1453	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87010297	STD -28	12:41665
1454	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87010295	STD -28	12:41691
1456	NTIS, PC A09/MF A01; 1 (GPO Dep.)	E 1.99: DE87011909	STD -28	12:41744
FRCR-				
295	*See* DOE/ER/53193-7	E 1.99: DE87012232	MN -20	12:42717
FRNC-TH-				
2328	NTIS (US Sales Only), PC A09/MF A01	DE87752535	MN -125	12:40459
FS-				
86-39-AKU	NTIS PC E09; Available from NTIS as TIB/B87-07745		ND -51	12:41975
GA-A-				
18566	NTIS, PC A02; 3	DE87003847	MN -77	12:40862
18780	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE87010825	STD -80	12:40930
18836	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87012304	STD -20	12:42719
18854	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011328	MN -20a	12:42778
18861	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011834	MN -20a	12:42720
18864	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011833	MN -20	12:42721
GEPP-CB-				
986	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99: DE87013100	MN -13	12:41868
GEPP-TIS-				
1016	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013851	MN -13	12:40778
GKSS-				
87/ E/ 3	NTIS PC E07; Available from NTIS as TIB/B87-07811		ND -78	12:41645
87/ E/ 5	NTIS PC E07; Available from NTIS as TIB/B87-09402		ND -25	12:41303
87/ E/ 6	NTIS PC E07; Available from NTIS as TIB/B87-09401		ND -25	12:41304
87/ E/ 7	NTIS PC E07; Available from NTIS as TIB/B87-09400		ND -25	12:41305
GL-				
4194	*See* AD-A-180341/0/XAB			12:41582
GR-				
85-5e	NTIS (US Sales Only), PC A05/MF A01	DE87702716	MN -41	12:42634
86-10	NTIS (US Sales Only), PC A08/MF A01	DE87702717	MN -41	12:41014
GSF-				
39/ 86	NTIS (US Sales Only), PC A05/MF A01; 1	DE87770224	MN -11	12:41948
GSI-				
87-10-Prepr.	NTIS (US Sales Only), PC A04/MF A01	DE87751874	MN -34C	12:42552
87-17-Prepr.	NTIS PC E07; Available from NTIS as TIB/B87-09393		ND -28	12:41692
HEDL-SA-				
3317	NTIS, PC A02; 3	DE87010724	MN -78	12:40857
3351	San Francisco Press, Inc., Box 6800, San Francisco, CA 94101-6800; 3	TI87010420	ND -25	12:41280
3447-FP	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87004093	MN -80	12:40931
3462	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87010713	MN -79b	12:40952
3471	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87009974	MN -79k	12:40878

Report Number	Availability Source	File Number	Distribution Category	Abstract Number
3497	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010719	MN -79b	12:40953
3526	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010728	MN -80	12:40881
3533	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87010712	MN -78	12:40831
3548	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011480	MN -80	12:41306
HETA-				
83-085-1757	*See* PB-87-189270/XAB			12:41099
HMI-B-				
433	NTIS PC E11; Available from NTIS as TIB/B87-07812		ND -25	12:41307
HPM-				
85-047	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012215	MN -41	12:41676
HRI-				
99	*See* PB-87-189544/XAB			12:41896
IAE-				
4150/ 1	NTIS (US Sales Only), PC A03/MF A01	DE87702718	MN -34D	12:42702
4168/ 6	NTIS (US Sales Only), PC A02/MF A01	DE87702719	MN -20	12:42722
4170/ 7	NTIS (US Sales Only), PC A02/MF A01	DE87702720	MN -20	12:42723
4173/ 6	NTIS (US Sales Only), PC A02/MF A01	DE87702721	MN -20	12:42724
4185/ 7	NTIS (US Sales Only), PC A02/MF A01	DE87702722	MN -20	12:42725
4194/ 7	NTIS (US Sales Only), PC A02/MF A01	DE87702723	MN -20	12:42726
4215/ 11	NTIS (US Sales Only), PC A02/MF A01	DE87702724	MN -34A	12:42643
4217/ 8	NTIS (US Sales Only), PC A04/MF A01	DE87702725	MN -20	12:42727
4218(7)	NTIS (US Sales Only), PC A02/MF A01	DE87702726	MN -20	12:42779
4225/ 10	NTIS (US Sales Only), PC A02/MF A01	DE87702727	MN -20	12:42728
4230/ 7	NTIS (US Sales Only), PC A03/MF A01	DE87702728	MN -20	12:42729
4265/ 1	NTIS (US Sales Only), PC A03/MF A01	DE87702729	MN -34A	12:42353
IAEA-INFCIRC-				
342	NTIS (US Sales Only), PC A02/MF A01	DE87702730	MN -2	12:40663
343	NTIS (US Sales Only), PC A02/MF A01	DE87702562	MN -2	12:40670
IAEA-R-				
3732-F	NTIS (US Sales Only), PC A02/MF A01	DE87702563	MN -23	12:42182
IAEA-RL-				
135	NTIS (US Sales Only), PC A11/MF A01	DE87702731	MN -4	12:41419
141	NTIS (US Sales Only), PC A06/MF A01	DE87702564	MN -4	12:41429
IAEA-TECDOC-				
382	NTIS (US Sales Only), PC A16/MF A01	DE87702732	MN -2	12:42904
400	NTIS (US Sales Only), PC A06/MF A01	DE87702733	MN -80	12:41017
403	NTIS (US Sales Only), PC A03/MF A01	DE87702734	MN -80	12:40942
406	NTIS (US Sales Only), PC A05/MF A01	DE87702735	MN -48	12:42262
408	NTIS (US Sales Only), PC A06/MF A01	DE87702736	MN -86	12:40480
411	NTIS (US Sales Only), PC A03/MF A01	DE87702565	MN -48	12:42184
IAN-				
1985	NTIS (US Sales Only), PC A04/MF A01	DE87702737	MN -2	12:41106
1986	NTIS (US Sales Only), PC A04/MF A01	DE87702738	MN -2	12:41107
IC-				
86/ 142	NTIS (US Sales Only), PC A02/MF A01	DE87702567	MN -34D	12:42703
86/ 152	NTIS (US Sales Only), PC A02/MF A01	DE87702568	MN -34A	12:42644
86/ 161	NTIS (US Sales Only), PC A02/MF A01	DE87702569	MN -34A	12:42645
86/ 170	NTIS (US Sales Only), PC A03/MF A01	DE87702570	MN -34D	12:42483
86/ 198	NTIS (US Sales Only), PC A02/MF A01	DE87702571	MN -34B	12:42315
86/ 212	NTIS (US Sales Only), PC A02/MF A01	DE87702572	MN -34A	12:42646
86/ 218	NTIS (US Sales Only), PC A02/MF A01	DE87702573	MN -34D	12:42704
86/ 224	NTIS (US Sales Only), PC A02/MF A01	DE87702574	MN -34D	12:42497
86/ 235	NTIS (US Sales Only), PC A04/MF A01	DE87702575	MN -34A	12:42647
86/ 243	NTIS (US Sales Only), PC A02/MF A01	DE87702576	MN -34D	12:42484
86/ 255	NTIS (US Sales Only), PC A02/MF A01	DE87702577	MN -34D	12:42705
86/ 258	NTIS (US Sales Only), PC A02/MF A01	DE87702578	MN -34D	12:42485
86/ 263	NTIS (US Sales Only), PC A02/MF A01	DE87702579	MN -34A	12:42354
86/ 264	NTIS (US Sales Only), PC A03/MF A01	DE87702580	MN -34D	12:42498
86/ 269	NTIS (US Sales Only), PC A02/MF A01	DE87702581	MN -34D	12:42499
86/ 270	NTIS (US Sales Only), PC A02/MF A01	DE87702582	MN -34A	12:42696
86/ 273	NTIS (US Sales Only), PC A02/MF A01	DE87702583	MN -34A	12:42648
86/ 274	NTIS (US Sales Only), PC A02/MF A01	DE87702584	MN -34A	12:42649
86/ 275	NTIS (US Sales Only), PC A02/MF A01	DE87702585	MN -34A	12:42650
86/ 278	NTIS (US Sales Only), PC A03/MF A01	DE87702586	MN -34D	12:42706
86/ 280	NTIS (US Sales Only), PC A02/MF A01	DE87702587	MN -34D	12:42707
86/ 282	NTIS (US Sales Only), PC A02/MF A01	DE87702588	MN -34D	12:42708
86/ 286	NTIS (US Sales Only), PC A02/MF A01	DE87702589	MN -34D	12:42486
86/ 290	NTIS (US Sales Only), PC A02/MF A01	DE87702590	MN -34A	12:42355
86/ 293	NTIS (US Sales Only), PC A02/MF A01	DE87702591	MN -34D	12:42500
IEPA/APC-				
86-022	*See* PB-87-188009/XAB			12:41893
IFT-P-				
05/ 86	NTIS (US Sales Only), PC A02/MF A01	DE87702739	MN -34D	12:42458
06/ 86	NTIS (US Sales Only), PC A02/MF A01	DE87702740	MN -34D	12:42459
IFVE-OEA-OEIPK-				
86-107	NTIS (US Sales Only), PC A02/MF A01	DE87702741	MN -37	12:41793
IFVE-OEF-				
86-109	NTIS (US Sales Only), PC A02/MF A01	DE87702742	MN -37	12:41794
86-148	NTIS (US Sales Only), PC A02/MF A01	DE87702743	MN -37	12:41795
IFVE-OEIPK-				
86-93	NTIS (US Sales Only), PC A02/MF A01	DE87702744	MN -34D	12:42422
IFVE-ONF-				
86-133	NTIS (US Sales Only), PC A02/MF A01	DE87702745	MN -34D	12:42423

Report Number	Availability Source	File Number	Distribution Category	Abstract Number
IFVE-ONF/OEA-				
86-179	NTIS (US Sales Only), PC A02/MF A01	DE87702746	MN -37	12:41796
IFVE-OP-				
86-147	NTIS (US Sales Only), PC A02/MF A01	DE87702747	MN -28	12:41745
IFVE-OTF-				
86-79	NTIS (US Sales Only), PC A02/MF A01	DE87702748	MN -34D	12:42460
86-126	NTIS (US Sales Only), PC A02/MF A01	DE87702749	MN -34D	12:42501
86-151	NTIS (US Sales Only), PC A02/MF A01	DE87702750	MN -34D	12:42461
86-166	NTIS (US Sales Only), PC A02/MF A01	DE87702751	MN -34D	12:42462
86-170	NTIS (US Sales Only), PC A02/MF A01	DE87702752	MN -34D	12:42463
86-171	NTIS (US Sales Only), PC A02/MF A01	DE87702753	MN -34D	12:42502
IKE-				
6-170	NTIS PC E14; Available from NTIS as TIB/B87-07774		ND -78	12:40858
INDC(BUL)-				
12	NTIS (US Sales Only), PC A02/MF A01	DE87702592	MN -34C	12:42593
INDC(CCP)-				
266/ G	NTIS (US Sales Only), PC A02/MF A01	DE87702754	MN -20	12:42780
INDC(IND)-				
038/ L	NTIS (US Sales Only), PC A02/MF A01	DE87702755	MN -34C	12:42595
INIS-BR-				
604	NTIS (US Sales Only), PC A03/MF A01	DE87702593	MN -41	12:41018
625	NTIS (US Sales Only), PC A02/MF A01	DE87702756	MN -37	12:41797
648	NTIS (US Sales Only), PC A02/MF A01	DE87702757	MN -34A	12:42651
649	NTIS (US Sales Only), PC A02/MF A01	DE87702758	MN -20	12:42730
650	NTIS (US Sales Only), PC A02/MF A01	DE87702759	MN -80	12:40904
652	NTIS (US Sales Only), PC A04/MF A01	DE87702760	MN -20	12:42731
653	NTIS (US Sales Only), PC A02/MF A01	DE87702761	MN -4	12:41430
654	NTIS (US Sales Only), PC A02/MF A01	DE87702762	MN -37	12:41798
655	NTIS (US Sales Only), PC A02/MF A01	DE87702763	MN -34B	12:42343
656	NTIS (US Sales Only), PC A02/MF A01	DE87702764	MN -11	12:42026
657	NTIS (US Sales Only), PC A02/MF A01	DE87702765	MN -37	12:41799
658	NTIS (US Sales Only), PC A02/MF A01	DE87702766	MN -51	12:40481
659	NTIS (US Sales Only), PC A02/MF A01	DE87702767	MN -51	12:41949
660	NTIS (US Sales Only), PC A02/MF A01	DE87702768	MN -34B	12:41930
661	NTIS (US Sales Only), PC A02/MF A01	DE87702769	MN -34B	12:41931
662	NTIS (US Sales Only), PC A15/MF A01	DE87702770	MN -51	12:40482
663	NTIS (US Sales Only), PC A18/MF A01	DE87702771	MN -11	12:42027
664	NTIS (US Sales Only), PC A02/MF A01	DE87702772	MN -4	12:41431
665	NTIS (US Sales Only), PC A06/MF A01	DE87702773	MN -34C	12:42596
666	NTIS (US Sales Only), PC A09/MF A01	DE87702774	MN -34A	12:42356
667	NTIS (US Sales Only), PC A05/MF A01	DE87702775	MN -34D	12:42503
668	NTIS (US Sales Only), PC A02/MF A01	DE87702776	MN -4	12:41359
669	NTIS (US Sales Only), PC A04/MF A01	DE87702777	MN -34A	12:42357
670	NTIS (US Sales Only), PC A02/MF A01	DE87702778	MN -25	12:41308
671	NTIS (US Sales Only), PC A02/MF A01	DE87702779	MN -4	12:41432
673	NTIS (US Sales Only), PC A02/MF A01	DE87702780	MN -25	12:41309
674	NTIS (US Sales Only), PC A02/MF A01	DE87702781	MN -41	12:40943
INIS-mf-				
9935	NTIS (US Sales Only), PC A02/MF A01	DE87780143	MN -34C	12:42511
9936	NTIS (US Sales Only), PC A02/MF A01	DE87780139	MN -48	12:42195
9937	NTIS (US Sales Only), PC A02/MF A01	DE87780138	MN -80	12:40815
9938	NTIS (US Sales Only), PC A02/MF A01	DE87780140	MN -11	12:42196
9939	NTIS (US Sales Only), PC A02/MF A01	DE87780141	MN -23	12:42185
9940	NTIS (US Sales Only), PC A02/MF A01	DE87780142	MN -80	12:41019
10610	NTIS (US Sales Only), PC A07/MF A01	DE87751868	MN -34C	12:42538
10636	NTIS PC E15; Available from NTIS as TIB/B87-07238		ND -37	12:41839
10647	NTIS PC E14; Available from NTIS as TIB/B87-07619		ND -48	12:42197
10666	NTIS PC E07; Available from NTIS as TIB/B87-09339		ND -80	12:41020
10667	NTIS PC E09; Available from NTIS as TIB/B87-09334		ND -25	12:41661
10671	NTIS PC E07; Available from NTIS as TIB/B87-08703		ND -25	12:41310
10882	NTIS (US Sales Only), PC A03/MF A01	DE87702782	MN -48	12:42267
10883	NTIS (US Sales Only), PC A03/MF A01	DE87702783	MN -34C	12:42597
10890	NTIS (US Sales Only), PC A05/MF A01	DE87702784	MN -23	12:42186
10905	NTIS (US Sales Only), PC A04/MF A01	DE87702595	MN -4	12:41433
10912	NTIS (US Sales Only), PC A05/MF A01	DE87702785	MN -41	12:41021
10917	NTIS (US Sales Only), PC A07/MF A01	DE87780153	MN -38	12:41625
10918	NTIS (US Sales Only), PC A03/MF A01	DE87780149	MN -34C	12:42402
10919	NTIS (US Sales Only), PC A05/MF A01	DE87702786	MN -16	12:41869
10920	NTIS (US Sales Only), PC A06/MF A01	DE87702787	MN -37	12:42424
10921	NTIS (US Sales Only), PC A06/MF A01	DE87702788	MN -34D	12:42464
10922	NTIS (US Sales Only), PC A09/MF A01	DE87702789	MN -34A	12:42680
10923	NTIS (US Sales Only), PC A07/MF A01	DE87702790	MN -34B	12:42316
10924	NTIS (US Sales Only), PC A09/MF A01	DE87702791	MN -25	12:42697
10925	NTIS (US Sales Only), PC A07/MF A01	DE87702792	MN -34C	12:42533
10926	NTIS (US Sales Only), PC A08/MF A01	DE87702793	MN -34A	12:42358
10928	NTIS (US Sales Only), PC A05/MF A01	DE87702794	MN -34D	12:42425
10929	NTIS (US Sales Only), PC A06/MF A01	DE87702795	MN -48	12:42234
10930	NTIS (US Sales Only), PC A04/MF A01	DE87702796	MN -23	12:42179

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10931	NTIS (US Sales Only), PC A11/MF A01	DE87702797	MN -48	12:42235
10932	NTIS (US Sales Only), PC A13/MF A01	DE87702798	MN -34B	12:42317
10933	NTIS (US Sales Only), PC A08/MF A01	DE87702799	MN -48	12:42171
10934	NTIS (US Sales Only), PC A03/MF A01	DE87702800	MN -70	12:40539
INIS-XN-				
55	NTIS (US Sales Only), PC A02/MF A01	DE87702801	MN -2	12:40483
56	NTIS (US Sales Only), PC A06/MF A01	DE87702802	MN -2	12:40540
58	NTIS (US Sales Only), PC A03/MF A01	DE87702599	MN -41	12:40651
59	NTIS (US Sales Only), PC A04/MF A01	DE87702600	MN -34B	12:41932
60	NTIS (US Sales Only), PC A03/MF A01	DE87702601	MN -48	12:42236
INPE-				
3604	NTIS (US Sales Only), PC A02/MF A01	DE87702803	MN -34B	12:42344
INS-				
576	NTIS (US Sales Only), PC A02/MF A01	DE87702602	MN -34C	12:42598
587	NTIS (US Sales Only), PC A02/MF A01	DE87702603	MN -34D	12:42465
IPNO-TH-				
86-13	NTIS (US Sales Only), PC A03/MF A01	DE87751828	MN -34C	12:42599
IPPCZ-				
255	NTIS (US Sales Only), PC A02/MF A01	DE87702804	MN -20	12:42732
256	NTIS (US Sales Only), PC A02/MF A01	DE87702805	MN -20	12:42733
260	NTIS (US Sales Only), PC A03/MF A01	DE87702806	MN -20	12:42734
IPPJ-				
764	NTIS (US Sales Only), PC A02/MF A01	DE87702605	MN -20	12:42735
766	NTIS (US Sales Only), PC A07/MF A01	DE87702606	MN -20	12:42736
768	NTIS (US Sales Only), PC A03/MF A01	DE87702607	MN -20	12:42737
IS-T-				
1234	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87013071	MN -25	12:41360
1309	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99: DE87012073	MN -25	12:41386
ITEP-				
109(1986)	NTIS (US Sales Only), PC A02/MF A01	DE87702807	MN -37	12:42783
122(1986)	NTIS (US Sales Only), PC A02/MF A01	DE87702808	MN -34D	12:42426
123(1986)	NTIS (US Sales Only), PC A02/MF A01	DE87702809	MN -34D	12:42427
151(1986)	NTIS (US Sales Only), PC A02/MF A01	DE87702810	MN -37	12:41801
ITEP-				
127(1986)	NTIS (US Sales Only), PC A02/MF A01	DE87702811	MN -34D	12:42466
128(1986)	NTIS (US Sales Only), PC A02/MF A01	DE87702812	MN -34D	12:42467
131(1986)	NTIS (US Sales Only), PC A02/MF A01	DE87702813	MN -34D	12:42468
134(1986)	NTIS (US Sales Only), PC A02/MF A01	DE87702608	MN -34D	12:42469
ITOP-				
2-2-603(1)	*See* AD-A-180601/7/XAB			12:41124
JAERI-				
1302	NTIS (US Sales Only), PC A13/MF A01	DE87702609	MN -32	12:40905
JAERI-M-				
86-081	NTIS (US Sales Only), PC A11/MF A01	DE87702610	MN -20	12:42784
86-096	NTIS (US Sales Only), PC A04/MF A01	DE87702611	MN -20	12:42785
86-103	NTIS (US Sales Only), PC A02/MF A01	DE87702612	MN -20	12:42786
86-113	NTIS (US Sales Only), PC A03/MF A01	DE87702613	MN -20	12:42787
86-114	NTIS (US Sales Only), PC A05/MF A01	DE87702614	MN -20	12:42739
86-118	NTIS (US Sales Only), PC A09/MF A01	DE87702615	MN -78	12:40832
86-120	NTIS (US Sales Only), PC A03/MF A01	DE87702814	MN -77	12:40863
86-129	NTIS (US Sales Only), PC A03/MF A01	DE87702616	MN -20	12:42788
86-132	NTIS (US Sales Only), PC A12/MF A01	DE87702617	MN -41	12:40652
86-134	NTIS (US Sales Only), PC A99/MF A01	DE87702618	MN -20	12:42789
86-136	NTIS (US Sales Only), PC A05/MF A01	DE87702619	MN -32	12:40954
86-137	NTIS (US Sales Only), PC A02/MF A01	DE87702620	MN -37	12:41802
86-138	NTIS (US Sales Only), PC A10/MF A01	DE87702621	MN -80	12:40955
86-139	NTIS (US Sales Only), PC A05/MF A01	DE87702622	MN -25	12:41311
86-140	NTIS (US Sales Only), PC A03/MF A01	DE87702623	MN -32	12:41022
86-141	NTIS (US Sales Only), PC A03/MF A01	DE87702624	MN -25	12:41387
86-142	NTIS (US Sales Only), PC A04/MF A01	DE87702625	MN -41	12:41023
86-144	NTIS (US Sales Only), PC A03/MF A01	DE87702626	MN -77	12:40864
86-145	NTIS (US Sales Only), PC A03/MF A01	DE87702627	MN -25	12:41388
86-146	NTIS (US Sales Only), PC A02/MF A01	DE87702628	MN -77	12:40865
86-147	NTIS (US Sales Only), PC A02/MF A01	DE87702629	MN -20	12:42790
86-148	NTIS (US Sales Only), PC A02/MF A01	DE87702630	MN -20	12:42791
86-151	NTIS (US Sales Only), PC A04/MF A01	DE87702631	MN -32	12:40906
86-152	NTIS (US Sales Only), PC A05/MF A01	DE87702632	MN -20	12:42792
86-153	NTIS (US Sales Only), PC A06/MF A01	DE87702633	MN -80	12:40956
86-154	NTIS (US Sales Only), PC A03/MF A01	DE87702634	MN -28	12:41746
86-155	NTIS (US Sales Only), PC A03/MF A01	DE87702635	MN -80	12:40957
86-156	NTIS (US Sales Only), PC A02/MF A01	DE87702636	MN -20	12:42740
86-157	NTIS (US Sales Only), PC A03/MF A01	DE87702637	MN -23	12:40677
86-158	NTIS (US Sales Only), PC A04/MF A01	DE87702638	MN -32	12:41024
86-165	NTIS (US Sales Only), PC A04/MF A01	DE87702639	MN -77	12:40866
86-170	NTIS (US Sales Only), PC A03/MF A01	DE87702640	MN -20	12:42793
86-171	NTIS (US Sales Only), PC A03/MF A01	DE87702641	MN -20	12:42741
86-172	NTIS (US Sales Only), PC A03/MF A01	DE87702642	MN -20	12:42742
86-173	NTIS (US Sales Only), PC A03/MF A01	DE87702643	MN -20	12:42794
86-174	NTIS (US Sales Only), PC A09/MF A01	DE87702644	MN -20	12:42743
86-175	NTIS (US Sales Only), PC A10/MF A01	DE87702645	MN -20	12:42744
86-180	NTIS (US Sales Only), PC A04/MF A01	DE87702646	MN -71	12:41595
86-181	NTIS (US Sales Only), PC A05/MF A01	DE87702647	MN -25	12:41312
86-182	NTIS (US Sales Only), PC A05/MF A01	DE87702648	MN -20	12:42795

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JEN-				
581	NTIS (US Sales Only), PC A05/MF A01	DE87702649	MN -48	12:42187
583	NTIS (US Sales Only), PC A03/MF A01	DE87702650	MN -32	12:41803
585	NTIS (US Sales Only), PC A05/MF A01	DE87702651	MN -48	12:42237
587	NTIS (US Sales Only), PC A02/MF A01	DE87702652	MN -4	12:41555
588	NTIS (US Sales Only), PC A02/MF A01	DE87702653	MN -4	12:41556
JINR-				
9-86-305	NTIS (US Sales Only), PC A02/MF A01	DE87702815	MN -28	12:41693
9-86-389	NTIS (US Sales Only), PC A02/MF A01	DE87702816	MN -28	12:41747
13-86-328	NTIS (US Sales Only), PC A02/MF A01	DE87702817	MN -37	12:41804
13-86-513	NTIS (US Sales Only), PC A02/MF A01	DE87702818	MN -28	12:41748
13-86-533	NTIS (US Sales Only), PC A02/MF A01	DE87702819	MN -28	12:41749
14-86-409	NTIS (US Sales Only), PC A02/MF A01	DE87702820	MN -25	12:41313
14-86-410	NTIS (US Sales Only), PC A02/MF A01	DE87702821	MN -25	12:41314
16-86-486	NTIS (US Sales Only), PC A02/MF A01	DE87702822	MN -28	12:41750
D-10-11-84-818	NTIS (US Sales Only), PC A16/MF A01	DE87780164	MN -32	12:42883
JINR-E-				
2-86-260	NTIS (US Sales Only), PC A02/MF A01	DE87702823	MN -34D	12:42472
2-86-466	NTIS (US Sales Only), PC A02/MF A01	DE87702824	MN -34D	12:42473
86-449	NTIS (US Sales Only), PC A02/MF A01	DE87702825	MN -34C	12:42603
JINR-R-				
1-86-403	NTIS (US Sales Only), PC A02/MF A01	DE87702826	MN -28	12:41758
1-86-427	NTIS (US Sales Only), PC A02/MF A01	DE87702827	MN -37	12:41819
2-86-431	NTIS (US Sales Only), PC A02/MF A01	DE87702828	MN -34D	12:42710
3-86-344	NTIS (US Sales Only), PC A02/MF A01	DE87702829	MN -37	12:41820
4-86-273	NTIS (US Sales Only), PC A02/MF A01	DE87702830	MN -34C	12:42604
4-86-339	NTIS (US Sales Only), PC A02/MF A01	DE87702831	MN -34D	12:42711
4-86-444	NTIS (US Sales Only), PC A02/MF A01	DE87702832	MN -34C	12:42605
7-86-306	NTIS (US Sales Only), PC A02/MF A01	DE87702833	MN -34C	12:42606
10-86-124	NTIS (US Sales Only), PC A02/MF A01	DE87702834	MN -70	12:40541
10-86-270	NTIS (US Sales Only), PC A02/MF A01	DE87702835	MN -37	12:41841
10-86-313	NTIS (US Sales Only), PC A02/MF A01	DE87702836	MN -32	12:41842
10-86-318	NTIS (US Sales Only), PC A02/MF A01	DE87702837	MN -32	12:41843
10-86-381	NTIS (US Sales Only), PC A02/MF A01	DE87702838	MN -32	12:42513
11-86-342	NTIS (US Sales Only), PC A02/MF A01	DE87702839	MN -37	12:41821
13-86-456	NTIS (US Sales Only), PC A02/MF A01	DE87702840	MN -37	12:41822
13-86-492	NTIS (US Sales Only), PC A02/MF A01	DE87702841	MN -28	12:41759
14-86-555	NTIS (US Sales Only), PC A02/MF A01	DE87702842	MN -4	12:41389
16-86-491	NTIS (US Sales Only), PC A02/MF A01	DE87702843	MN -37	12:41823
Jucl-				
2083	NTIS PC E14; Available from NTIS as TIB/B87-09409		ND -25	12:41390
2093	NTIS PC E09; Available from NTIS as TIB/B87-07778		ND -77	12:40867
2094	NTIS PC E11; Available from NTIS as TIB/B87-07808		ND -20f	12:42747
2103	NTIS PC E14; Available from NTIS as TIB/B87-09390		ND -80	12:41025
2112	NTIS (US Sales Only), PC A06/MF A01; 1	DE87770230	MN -4	12:41499
Jucl-Spez-				
374	NTIS PC E09; Available from NTIS as TIB/B87-07732		ND -80	12:41026
378	NTIS PC E07; Available from NTIS as TIB/B87-07807		ND -77	12:40868
381	NTIS (US Sales Only), PC A05/MF A01; 1	DE87770228	MN -48	12:42268
K/CSD/INF-				
87-13	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012680	MN -16	12:40665
K/CSD/TM-				
64-Rev.1	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99: DE87011916	MN -32	12:42900
K/ETAC-				
5	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87012036	MN -25	12:41391
K/TIP-				
131	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE87011702	MN -22	12:40675
K/QT-				
104	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87011378	MN -37	12:41844
KAPL-				
4196	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87012989	MN -41	12:40610
KEK-				
85-15	NTIS (US Sales Only), PC A02/MF A01	DE87702654	MN -28	12:41788
85-16	NTIS (US Sales Only), PC A08/MF A01	DE87702655	MN -34A	12:42681
KFK-				
4074	NTIS PC E11; Available from NTIS as TIB/B87-09406		ND -20d	12:41392
4145	NTIS PC E11; Available from NTIS as TIB/B87-09397		ND -78	12:40859
4176	NTIS PC E07; Available from NTIS as TIB/B87-07775		ND -34A	12:42360
4180	NTIS PC E14; Available from NTIS as TIB/B87-07776		ND -34D	12:42428
4195	NTIS PC E09; Available from NTIS as TIB/B87-07809		ND -38	12:41596
KFK-PEF-				
11	NTIS (US Sales Only), PC A05/MF A01; 1	DE87770231	MN -48	12:41961

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KFKI-				
1986-87/ G	NTIS (US Sales Only), PC A02/MF A01	DE87702844	MN -78	12:41027
KLD-TR-				
146	*See* PB-87-187712/XAB			12:41220
172B	*See* PB-87-187688/XAB			12:41218
172C	*See* PB-87-187704/XAB			12:41219
KU-HCOE-FL2-R-				
85-16	NTIS (US Sales Only), PC A02/MF A01	DE87752326	MN -25	12:41361
85-18	NTIS (US Sales Only), PC A02/MF A01	DE87752328	MN -25	12:41362
85-19	NTIS (US Sales Only), PC A02/MF A01	DE87752333	MN -34A	12:42682
85-20	NTIS (US Sales Only), PC A02/MF A01	DE87752332	MN -34A	12:42683
86-1	NTIS (US Sales Only), PC A02/MF A01	DE87752331	MN -25	12:41363
86-4	NTIS (US Sales Only), PC A02/MF A01	DE87752336	MN -34A	12:42684
86-6	NTIS (US Sales Only), PC A03/MF A01	DE87752327	MN -38	12:41646
86-02	NTIS (US Sales Only), PC A04/MF A01	DE87752330	MN -34A	12:42685
86-03	NTIS (US Sales Only), PC A02/MF A01	DE87752334	MN -34A	12:42686
86-05	NTIS (US Sales Only), PC A02/MF A01	DE87752329	MN -25	12:41315
86-13	NTIS (US Sales Only), PC A02/MF A01	DE87752335	MN -25	12:41316
KURRI-TR-				
276	NTIS (US Sales Only), PC A03/MF A01	DE87702656	MN -80	12:40944
LA-				
10763-SR	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87012703	STD -59B	12:40691
10856-M	*See* NUREG/CR-4765	TI87006256	MN -80	12:40924
10872-MS	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87006309	STD -33A	12:41126
10906	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010648	MN -4	12:40489
11009-MS	NTIS, PC A09/MF A01; 1 (GPO Dep.)	E 1.99: DE87011849	MN -32	12:42404
11019-MS	*See* NUREG/CR-4931	TI87011379	MN -80	12:40925
11044-T	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99: DE87012049	MN -37	12:41666
11051-T	NTIS, PC A13/MF A01; 1 (GPO Dep.)	E 1.99: DE87012983	MN -79	12:40879
11054-MS	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99: DE87012107	MN -28	12:41718
LA-tr-				
87-10	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87012688	MN -41	12:42284
LA-UR-				
86-145	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86006015	MN -38	12:41597
87-116	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87005110	MN -78	12:41028
87-117	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87005109	MN -78	12:41647
87-118	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87005108	MN -78	12:41029
87-167	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87005102	MN -78	12:41030
87-1408	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87009009	MN -32	12:42901
87-1412	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87009010	MN -78	12:41031
87-1464	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87009014	MN -11	12:41874
87-1471	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87009015	MN -11	12:41875
87-1657	NTIS, PC A02; 3	DE87010120	MN -11	12:41889
87-1678	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010122	MN -11	12:41890
87-1704	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010123	MN -11	12:41876
87-1745	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010130	MN -11	12:41877
87-1929	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011786	MN -20d	12:42748
87-1967	NTIS, PC A02; 3	DE87011780	MN -34A	12:42361
87-2036	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011771	MN -34C	12:42516
87-2037	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011770	MN -34C	12:42607
87-2096	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011762	MN -34D	12:42474
87-2101	NTIS, PC A02; 3	DE87011761	MN -38	12:41667
87-2138	NTIS, PC A02; 3	DE87011741	MN -38	12:41668
87-2251	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011727	MN -38	12:41598
87-2284	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013142	MN -25	12:41317
87-2285	NTIS, PC A02; 3	DE87013143	MN -94cc	12:41131
87-2292	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013144	MN -45	12:41857
87-2293	NTIS, PC A02; 3	DE87013145	MN -15	12:41434
87-2295	NTIS, PC A02; 3	DE87013146	MN -15	12:40666
87-2337	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013154	MN -25	12:41393
87-2349	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013155	MN -15	12:40667
87-2366	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013156	MN -25	12:41318
87-2393	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87013160	MN -93	12:41132
87-2449	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013161	MN -25	12:41319
87-2466	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87013166	MN -45	12:41858
LAFI-				
094	NTIS (US Sales Only), PC A02/MF A01	DE87702845	MN -34A	12:42687
LAIR-				
87-67	*See* AD-A-180422/8/XAB			12:41495
LBL-				
21519	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99: DE87010746	MN -28	12:41694
22203	NTIS, PC A02; 3	DE87009328	MN -28	12:41760
22243	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010256	MN -28	12:41695
22272	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010261	MN -28	12:42796
22404	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99: DE87007608	MN -34D	12:42475
22908	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87006947	MN -95d	12:41150
23160	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87010974	MN -28	12:41761
23247	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87012879	MN -34D	12:42505
23324	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87011215	MN -28	12:41696
23370	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011225	MN -70	12:40542
23415	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010259	MN -34C	12:42608
23450	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99: DE87012882	MN -48	12:42180
23521	NTIS, PC A02; 3	DE87011099	MN -38	12:41648
23523	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87012892	MN -25	12:42688

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23535	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87012888	MN -25	12:41320
23537	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012891	MN -25	12:41321
23585	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012893	MN -4	12:41500
23629	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012883	MN -41	12:42269
23701	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87012894	MN -4	12:41501
LYCEN-TH-				
8627	NTIS (US Sales Only), PC A08/MF A01	DE87752274	MN -34D	12:42429
MCR-				
85-721	*See* AD-A-180456/6/XAB			12:41376
MEA-				
2194	*See* NUREG/CR-4863	DE87900923	MN -78	12:40860
2207-Vol.5	*See* NUREG/CR-3228-Vol.5	TI87900921	MN -78	12:40833
MINTEK-M-				
297	NTIS (US Sales Only), PC A02/MF A01; 1	DE87900931	MN -25	12:41435
307	NTIS (US Sales Only), PC A02/MF A01; 1	DE87900932	MN -25	12:41394
MLM-				
3437(OP)	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011839	MN -48	12:42238
MMS/AK/EIS-				
84/ 02	*See* PB-87-193405/XAB			12:40425
85/ 001	*See* PB-87-192845/XAB			12:40423
85/ 002	*See* PB-87-192852/XAB			12:40424
85/ 003	*See* PB-87-192829/XAB			12:40421
85/ 004	*See* PB-87-192837/XAB			12:40422
MPI-PAE-Exp.El.-				
172	NTIS PC E07; Available from NTIS as TIB/B87-07665		ND -34D	12:42430
N-				
87-21785	NTIS, PC A21/MF A01			12:42319
87-23563	NTIS, PC A02/MF A01			12:42331
87-23564	NTIS, PC A02/MF A01			12:42332
NAGRA-NTB-				
84-01	Nagra, CH-5401 Baden, Switzerland		ND -25	12:40543
84-05	Nagra, CH-5401 Baden, Switzerland		ND -70	12:40544
84-06	Nagra, CH-5401 Baden, Switzerland		ND -51	12:40545
84-07	Nagra, CH-5401 Baden, Switzerland		ND -70	12:40546
84-08	Nagra, CH-5401 Baden, Switzerland		ND -70	12:40547
84-09	Nagra, CH-5401 Baden, Switzerland		ND -70	12:40548
84-10	Nagra, CH-5401 Baden, Switzerland		ND -70	12:40549
84-11	Nagra, CH-5401 Baden, Switzerland		ND -51	12:42296
84-12	Nagra, CH-5401 Baden, Switzerland		ND -51	12:42297
84-13	Nagra, CH-5401 Baden, Switzerland		ND -51	12:40550
84-14	Nagra, CH-5401 Baden, Switzerland		ND -51	12:42298
84-15	Nagra, CH-5401 Baden, Switzerland		ND -51	12:42299
84-16	Nagra, CH-5401 Baden, Switzerland		ND -51	12:42290
84-17	Nagra, CH-5401 Baden, Switzerland		ND -51	12:42300
84-18	Nagra, CH-5401 Baden, Switzerland		ND -25	12:40551
84-19	Nagra, CH-5401 Baden, Switzerland		ND -25	12:40552
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84-30	Nagra, CH-5401 Baden, Switzerland		ND -51	12:42308
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NAS-				
1.26:180928	*See* N-87-23564			12:42332
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179490	*See* DOE/NASA-0206-16	E 1.99: DE87013415	STD -110	12:41130
180803	*See* DOE/NASA-0330-2	E 1.99: DE87013124	STD -60	12:40745
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NAVORD-				
4215(EX)	*See* AD-A-995468/6/XAB			12:41867
NCAR/TN-				
282-STR	*See* PB-87-190633/XAB			12:41898
NDRL-				
2992	*See* DOE/ER/00038-2992	E 1.99: DE87012748	MN -4	12:41548
3009	*See* DOE/ER/00038-3009	E 1.99: DE87013390	MN -4	12:41549
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NHRC-				
34	*See* AD-A-180300/6/XAB			12:42287
NIIAR-				
22(703)	NTIS (US Sales Only), PC A02/MF A01	DE87702846	MN -25	12:41323
27(708)	NTIS (US Sales Only), PC A03/MF A01	DE87702847	MN -80	12:40870

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NIKHEF-K-DIGEL-					
68	NTIS (US Sales Only), PC A03/MF A01		DE87702848	MN -37	12:42884
70	NTIS (US Sales Only), PC A04/MF A01		DE87702849	MN -37	12:41824
71	NTIS (US Sales Only), PC A02/MF A01		DE87702850	MN -37	12:41847
NIKHEF-K-LINO-					
134	NTIS (US Sales Only), PC A02/MF A01		DE87702851	MN -37	12:41848
NIPER-					
127	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87001246	STD -122	12:40430
205	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87001253	STD -125	12:40457
245	NTIS, PC A13; 3		DE87001254	STD -125	12:40458
NOAA/TM/NOS/OMA-					
11	*See* PB-87-190666/XAB				12:42017
NOSC/TD-					
1032	*See* AD-A-180050/7/XAB				12:41883
NOSC/TR-					
1039	*See* AD-A-180285/9/XAB				12:42867
NP-					
7752777	NTIS (US Sales Only), PC A11; 3		DE87752777	MN -11	12:42012
7770180	NTIS (US Sales Only), PC A08; 3			MN -98	12:41088
7770182	NTIS (US Sales Only), PC A10; 1		DE87770182	MN -11	12:41093
7770183	NTIS (US Sales Only), PC A03/MF A01; 1		DE87770183	MN -38	12:41649
7770185	NTIS (US Sales Only), PC A03/MF A01; 1		DE87770185	MN -11	12:41962
7770186	NTIS (US Sales Only), PC A09/MF A01; 1		DE87770186	MN -11	12:41891
7770187	NTIS (US Sales Only), PC A03/MF A01; 1		DE87770187	MN -11	12:41878
7770189	NTIS (US Sales Only), PC A07; 3		DE87770189	MN -11	12:41879
7770191	NTIS (US Sales Only), PC A07; 3		DE87770191	MN -60	12:40741
7770192	NTIS (US Sales Only), PC A17; 3		DE87770192	MN -11	12:41880
7770193	NTIS (US Sales Only), PC A09; 3		DE87770193	MN -11	12:42013
7770220	NTIS (US Sales Only), PC A03/MF A01; 1		DE87770220	MN -11	12:42035
7770221	NTIS (US Sales Only), PC A04/MF A01; 1		DE87770221	MN -11	12:41943
7770222	NTIS (US Sales Only), PC A02; 3		DE87770222	MN -11	12:41944
7770225	NTIS (US Sales Only), PC A06; 3		DE87770225	MN -11	12:42270
7770226	NTIS (US Sales Only), PC A03/MF A01; 1		DE87770226	MN -11	12:41892
7770227	NTIS (US Sales Only), PC A04/MF A01; 1		DE87770227	MN -98	12:41114
7770229	NTIS (US Sales Only), PC A09/MF A01; 1		DE87770229	MN -11	12:41950
7770232	NTIS (US Sales Only), PC A07; 3		DE87770232	MN -48	12:42271
7770233	NTIS (US Sales Only), PC A09; 3		DE87770233	MN -109	12:40342
7770234	NTIS (US Sales Only), PC A07; 3		DE87770234	MN -38	12:41650
7770235	NTIS (US Sales Only), PC A13; 3		DE87770235	MN -48	12:42272
7770236	NTIS (US Sales Only), PC A07; 3		DE87770236	MN -11	12:40436
7770237	NTIS (US Sales Only), PC A07/MF A01; 1		DE87770237	MN -116	12:40399
7770238	NTIS (US Sales Only), PC A09; 3		DE87770238	MN -48	12:42273
7770239	NTIS (US Sales Only), PC A09; 3		DE87770239	MN -102	12:40343
7770240	NTIS (US Sales Only), PC A06; 3		DE87770240	MN -116	12:40400
7770241	NTIS (US Sales Only), PC A07; 3		DE87770241	MN -109	12:40344
7770242	NTIS (US Sales Only), PC A05; 3		DE87770242	MN -116	12:40416
NRCN-					
567	NTIS (US Sales Only), PC A07/MF A01		DE87702852	MN -46	12:40907
568	NTIS (US Sales Only), PC A02/MF A01		DE87702853	MN -23	12:42637
572	NTIS (US Sales Only), PC A02/MF A01		DE87702854	MN -20	12:42797
NRCN(TN)-					
092	NTIS (US Sales Only), PC A02/MF A01		DE87702855	MN -4	12:41557
106	NTIS (US Sales Only), PC A02/MF A01		DE87702856	MN -25	12:41662
NSMRL-					
1092	*See* AD-A-180486/3/XAB				12:42188
NUC/ARP-					
87-07	*See* AD-A-180277/6/XAB				12:40434
NUREG-					
0090-Vol.9-No.2	NTIS, PC A04/MF A01 - GPO		TI87900520	MN -80	12:41032
0304-Vol.12-No.1	NTIS, PC A04/MF A01 - GPO		TI87900691	MN -2	12:40890
0683-Suppl.2-Final	NTIS, PC A06 - GPO		DE87900880	MN -78	12:41033
0750-Vol.24-No.3	NTIS, PC A05/MF A01 - GPO		TI87900556	MN -80	12:41108
0750-Vol.24-No.6	NTIS, PC A08 - GPO		DE87900840	MN -80	12:40891
0800(6/ 87)	NTIS, PC A99/MF A01 - GPO		TI87900878	MN -78	12:40892
0837-Vol.7-No.1	NTIS, PC A10 - GPO		DE87900919	MN -41	12:40653
1002-Suppl.4	NTIS, PC A02/MF A01 - GPO		TI87900900	MN -78	12:41034
1047-Suppl.6	NTIS, PC A04/MF A01 - GPO		TI87900886	MN -78	12:41035
1214-Rev.1	NTIS, PC A04/MF A01 - GPO		TI87900578	MN -80	12:40893
1285	NTIS, PC A04/MF A01 - GPO		TI87900906	MN -78	12:40894
NUREG/CR-					
2000-Vol.6-No.5	NTIS, PC A06/MF A01 - GPO		TI87011842	MN -80	12:41043
2000-Vol.6-No.6	NTIS, PC A07/MF A01 - GPO		TI87013101	MN -80	12:40895
3228-Vol.5	NTIS, PC A11/MF A01 - GPO		TI87900921	MN -78	12:40833
4300-Vol.4-No.1	NTIS, PC A02/MF A01 - GPO		TI87011711	MN -80	12:40834
4407	NTIS PC E07/MF A01 - GPO		TI87012379	MN -78	12:41044
4469-Vol.6	NTIS, PC A04/MF A01 - GPO		TI87011627	MN -78	12:40896
4531	NTIS, PC A07/MF A01 - GPO		TI87007047	MN -80	12:41045
4550-Vol.6-Pt.1	NTIS, PC A22/MF A01 - GPO		TI87011843	MN -78	12:41046
4550-Vol.6-Pt.2	NTIS, PC A24 - GPO		DE87011844	MN -78	12:41047
4583-Vol.2	NTIS, PC A05/MF A01 - GPO		TI87011710	MN -78	12:40835
4626-Vol.2	NTIS, PC A03/MF A01 - GPO		TI87006795	MN -80	12:40937
4710	NTIS, PC A99/MF A01 - GPO		TI87013103	MN -78	12:41048
4744-Vol.1-No.2	NTIS, PC A04/MF A01 - GPO		TI87009441	MN -78	12:40836
4765	NTIS, PC A04/MF A01 - GPO		TI87006256	MN -80	12:40924

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4768-Vol.1	NTIS, PC A04/MF A01 - GPO		TI87012739	MN -78	12:41049
4768-Vol.2	NTIS, PC A05/MF A01 - GPO		TI87012740	MN -78	12:41050
4781	NTIS, PC A99/MF A01 - GPO		TI87011925	MN -78	12:41051
4805/ 1	NTIS, PC A16/MF A01 - GPO		TI87012056	MN -80	12:41052
4817	NTIS, PC A03/MF A01 - GPO		TI87009813	MN -78	12:41053
4851	NTIS PC E03/MF A01 - GPO		TI87900915	MN -11	12:42301
4859	NTIS, PC A08/MF A01 - GPO		TI87900555	MN -80	12:41063
4863	NTIS, PC A05 - GPO		DE87900923	MN -78	12:40860
4871	NTIS, PC A04/MF A01 - GPO		TI87012097	MN -78	12:40945
4886	NTIS, PC A04/MF A01 - GPO		TI87009582	MN -78	12:41064
4887	NTIS, PC A04/MF A01 - GPO		TI87012684	MN -80	12:41065
4891	NTIS, PC A03/MF A01 - GPO		TI87013281	MN -78	12:41066
4896	NTIS, PC A08/MF A01 - GPO		TI87012896	MN -80	12:41067
4905	NTIS, PC A10/MF A01 - GPO		DE87012179	MN -80	12:41068
4919	NTIS, PC A15/MF A01 - GPO		TI87900920	MN -11	12:40561
4925	NTIS PC E10/MF A01 - GPO; 1		TI87011023	MN -78	12:41069
4931	NTIS PC E05/MF A01 - GPO		TI87011379	MN -80	12:40925
4952	NTIS, PC A05/MF A01 - GPO		TI87900901	MN -38	12:41663
4974	NTIS, PC A02/MF A01 - GPO		TI87900908	MN -11	12:42302
4975	NTIS, PC A03 - GPO		DE87900907	MN -11	12:42303
OA-Trans-					
2819	NTIS (US Sales Only), PC A03/MF A01; 1		DE87900905	MN -97a	12:41675
OMI-					
162	*See* AD-A-180268/5/XAB				12:41872
ORAU/IEA-					
25(1986)	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013669	MN -2	12:41090
ORNL-					
4169/ V2/ S3	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87011966	STD -80	12:41070
6230	NTIS, PC A12/MF A01; 1		DE87013357	MN -13	12:41091
6240	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013358	MN -41	12:40958
6356	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012679	MN -41	12:42274
6368	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013359	STD -80	12:40898
6405/ R1	NTIS, PC A05/MF A01 (GPO Dep.)	E 1.99:	DE87013362	MN -11	12:41094
ORNL/CON-					
226	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012758	MN -95d	12:41151
ORNL/CSD/TM-					
248	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013188	MN -71	12:40495
254	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87011972	MN -32	12:42885
ORNL/FEDC-					
87/ 4	NTIS, PC A02/MF; 1		DE87011974	STD -20c	12:42798
ORNL/FETEP-					
20	NTIS, PC A09; 3		DE87013378	STD -109	12:40345
ORNL/M-					
349	*See* DOE/ER-0331	E 1.99:	DE87012029	MN -11	12:41973
362	NTIS, PC A15/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011928	MN -32	12:42886
393	NTIS, PC A10/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013343	MN -95	12:41115
ORNL/NSIC-					
200-Vol.6-No.5	*See* NUREG/CR-2000-Vol.6-No.5		TI87011842	MN -80	12:41043
200-Vol.6-No.6	*See* NUREG/CR-2000-Vol.6-No.6		TI87013101	MN -80	12:40895
ORNL/SGMP-					
87/ 1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013353	MN -114	12:40346
ORNL/Sub-					
79-42539/ 8	NTIS, PC A10/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013344	MN -95d	12:41152
85-00200/ 2	NTIS, PC A13/MF A01 (GPO Dep.)	E 1.99:	DE87013354	STD -97a	12:40813
87-37733/ 1	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013356	STD -11	12:40668
ORNL/TM-					
10195	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011960	MN -80	12:40899
10196	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011845	MN -41	12:41825
10234	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013372	MN -95d	12:41253
10330	*See* NUREG/CR-4817		TI87009813	MN -78	12:41053
10389	*See* NUREG/CR-4886		TI87009582	MN -78	12:41064
10397	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99:	DE87011950	MN -38	12:41599
10432	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011946	MN -80	12:40959
10452	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE87011705	MN -32	12:42887
OSWER-					
9523.00-2A	*See* PB-87-193702/XAB				12:41994
PAPO-					
87-06	Performance Assurance Project Office, Bldg. 9204-1, MS-10, Oak Ridge, TN 37831		TI87004573	ND -80	12:41109
PATENTS-US-	(US: Commissioner of Patents, Washington, DC 20231, USA, $1.50 per copy.)				
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4,675,101				12:40347
4,675,145				12:42514
4,675,146				12:40938
4,675,464				12:41515
PB-				
87-172375/ XAB	NTIS PC PC E99/MF E99			12:41264
87-172383/ XAB	NTISPC$57.00/MF$16.50			12:41265
87-172391/ XAB	NTISPC$63.50/MF$16.50			12:41266
87-172409/ XAB	NTISPC$43.50/MF$16.50			12:41267
87-172417/ XAB	NTISPC$32.50/MF$16.50			12:41268
87-172425/ XAB	NTISPC$44.50/MF$16.50			12:41269
87-172433/ XAB	NTISPC$39.00/MF$16.50			12:41270
87-176467/ XAB	NTIS, PC A02/MF A01			12:40730
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87-182028/ XAB	NTIS, PC A06/MF A01			12:42333
87-183273/ XAB	NTIS, PC A03/MF A01			12:41215
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87-184214/ XAB	NTIS, PC A18/MF A01			12:41600
87-186490/ XAB	NTISCP T02			12:41095
87-186508/ XAB	NTISCP T02			12:41096
87-186516/ XAB	NTISCP T02			12:41097
87-187142/ XAB	NTIS, PC A05/MF A01			12:40785
87-187399/ XAB	NTIS, PC A04/MF A01			12:42033
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87-188124/ XAB	NTIS, PC A02/MF A01			12:41933
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87-188173/ XAB	NTIS, PC A09/MF A01			12:41223
87-188181/ XAB	NTIS, PC A04/MF A01			12:41224
87-188421/ XAB	NTIS PC PC E04/MF E01			12:40562
87-188512/ XAB	NTIS, PC A08/MF A01			12:41895
87-188686/ XAB	NTIS, PC A13/MF A01			12:42014
87-188702/ XAB	NTIS, PC A06/MF A01			12:42015
87-188710/ XAB	NTIS, PC A06/MF A01			12:40401
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87-188918/ XAB	NTIS, PC A09/MF A01			12:41098
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87-188975/ XAB	NTIS PC PC E05/MF E05			12:41111
87-189239/ XAB	NTIS, PC A10/MF A01			12:40420
87-189270/ XAB	NTIS, PC A06/MF A01			12:41099
87-189544/ XAB	NTIS, PC A06/MF A01			12:41896
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87-189569/ XAB	NTIS, PC A99/MF E04			12:40438
87-189577/ XAB	NTIS, PC A99/MF E04			12:40439
87-189619/ XAB	NTIS, PC A15/MF A01			12:40440
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87-189841/ XAB	NTIS, PC A07/MF A01			12:41897
87-190336/ XAB	NTIS, PC A14/MF A01			12:40441
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87-190849/ XAB	NTIS PC PC E04/MF E04			12:42304
87-190856/ XAB	NTIS, PC A06/MF A01			12:41105
87-190880/ XAB	NTIS, PC A06/MF A01			12:41899
87-190906/ XAB	NTIS PC PC E05/MF E05			12:40356
87-190948/ XAB	NTIS PC PC E04/MF E04			12:40396
87-191383/ XAB	NTIS, PC A23/MF A01			12:41963
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87-191573/ XAB	NTIS, PC A02/MF A01			12:41905
87-191623/ XAB	NTIS, PC A03/MF A01			12:41254
87-191664/ XAB	NTIS, PC A10/MF A01			12:42018
87-191698/ XAB	NTIS, PC A02/MF A01			12:42019
87-191706/ XAB	NTIS, PC A03/MF A01			12:42276

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87-191797/ XAB	NTIS, PC A03/MF A01			12:41906
87-191839/ XAB	NTIS, PC A02/MF A01			12:41907
87-191847/ XAB	NTIS, PC A02/MF A01			12:41936
87-191946/ XAB	NTIS, PC A20/MF A01			12:40442
87-191961/ XAB	NTIS, PC A20/MF A01			12:40443
87-191995/ XAB	NTIS, PC A20/MF A01			12:40444
87-192001/ XAB	NTIS, PC A20/MF A01			12:40445
87-192019/ XAB	NTIS, PC A20/MF A01			12:40446
87-192027/ XAB	NTIS, PC A20/MF A01			12:40447
87-192035/ XAB	NTIS, PC A20/MF A01			12:40448
87-192043/ XAB	NTIS, PC A21/MF A01			12:40449
87-192050/ XAB	NTIS, PC A21/MF A01			12:40450
87-192068/ XAB	NTIS, PC A21/MF A01			12:40451
87-192118/ XAB	NTIS, PC A99/MF A01			12:40452
87-192191/ XAB	NTIS, PC A99/MF A01			12:42000
87-192209/ XAB	NTIS, PC A99/MF A01			12:42001
87-192217/ XAB	NTIS, PC A99/MF A01			12:40453
87-192225/ XAB	NTIS, PC A99/MF A01			12:40454
87-192241/ XAB	NTIS, PC A99/MF A01			12:42002
87-192266/ XAB	NTIS, PC A99/MF E04			12:42003
87-192399/ XAB	NTIS, PC A99/MF E04			12:42004
87-192407/ XAB	NTIS, PC A99/MF E04			12:42005
87-192530/ XAB	NTIS, PC A09/MF A01			12:40455
87-192662/ XAB	NTIS, PC A06/MF A01			12:42020
87-192829/ XAB	NTIS, PC A24/MF A01			12:40421
87-192837/ XAB	NTIS, PC A99/MF A01			12:40422
87-192845/ XAB	NTIS, PC A25/MF A01			12:40423
87-192852/ XAB	NTIS, PC A11/MF A01			12:40424
87-193371/ XAB	NTIS, PC A13/MF A01			12:41990
87-193389/ XAB	NTIS, PC A03/MF A01			12:41991
87-193397/ XAB	NTIS, PC A11/MF A01			12:41992
87-193405/ XAB	NTIS, PC A10/MF A01			12:40425
87-193421/ XAB	NTIS, PC A99/MF E04			12:41964
87-193439/ XAB	NTIS, PC A99/MF E04			12:41965
87-193447/ XAB	NTIS, PC A99/MF E06			12:41966
87-193454/ XAB	NTIS, PC A99/MF E06			12:41967
87-193462/ XAB	NTIS, PC A99/MF E06			12:41968
87-193470/ XAB	NTIS, PC A99/MF E08			12:41969
87-193546/ XAB	NTIS, PC A03/MF A01			12:41908
87-193611/ XAB	NTIS, PC A03/MF A01			12:41909
87-193678/ XAB	NTIS, PC A02/MF A01			12:41271
87-193694/ XAB	NTIS, PC A04/MF A01			12:41993
87-193702/ XAB	NTIS, PC A04/MF A01			12:41994
87-193710/ XAB	NTIS, PC A07/MF A01			12:41995
87-194098/ XAB	NTIS, PC A02/MF A01			12:41255
87-194106/ XAB	NTIS, PC A06/MF A01			12:41256
87-194114/ XAB	NTIS, PC A05/MF A01			12:41257
87-194122/ XAB	NTIS, PC A02/MF A01			12:41258
87-194130/ XAB	NTIS, PC A10/MF A01			12:41996
87-194155/ XAB	NTIS PC PC E03/MF E01			12:41910
87-194163/ XAB	NTIS PC PC E04/MF E01			12:41911
87-194247/ XAB	NTIS, PC A14/MF A01			12:42021
87-194262/ XAB	NTIS, PC A04/MF A01			12:41112
87-194429/ XAB	NTIS, PC A04/MF A01			12:41113
87-194692/ XAB	NTIS, PC A03/MF A01			12:41272
87-195343/ XAB	NTIS, PC A02/MF A01			12:41100
87-195459/ XAB	NTIS, PC A02/MF A01			12:41912
87-195962/ XAB	NTIS, PC A03/MF A01			12:41913
87-196184/ XAB	NTIS, PC A02/MF A01			12:42277
87-198735/ XAB	NTIS, PC A11/MF A01			12:41914
PNL-				
5511-Vol.4-No.1	*See* NUREG/CR-4300-Vol.4-No.1	TI87011711	MN -80	12:40834
5711-Vol.6	*See* NUREG/CR-4469-Vol.6	TI87011627	MN -78	12:40896
5822-Vol.2	*See* NUREG/CR-4583-Vol.2	TI87011710	MN -78	12:40835
5876-Vol.2	*See* NUREG/CR-4626-Vol.2	TI87006795	MN -80	12:40937
6032-1	*See* NUREG/CR-4768-Vol.1	TI87012739	MN -78	12:41049
6032-2	*See* NUREG/CR-4768-Vol.2	TI87012740	MN -78	12:41050
6164	*See* NUREG/CR-4891	TI87013281	MN -78	12:41066
6278	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87013581	MN -93	12:41682
6286	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87013122	MN -11	12:42006
PNL-SA-				
13184	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012171	MN -48	12:42281
13188	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012163	MN -48	12:42282
13786	NTIS, PC A02; 3	DE87012060	MN -34A	12:42362
13791	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012059	MN -41	12:40655
14228	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86015530	MN -80	12:40960
14316	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87011144	MN -11	12:41826
14372	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87002711	MN -80	12:40882
14590	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011989	MN -32	12:42888
14650	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013325	MN -102	12:40357
14764	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012161	MN -41	12:42246
14843	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012169	MN -11	12:41970
14864	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012168	MN -95d	12:41153
14865	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87011985	MN -60	12:40742

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14915	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012162	MN -41	12:42247
14930	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013326	MN -114	12:41364
POEF-T-				
3452	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87013087	MN -22	12:40484
3453	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012057	MN -38	12:41601
PSI-				
1024/ TR-693	*See* DOE/PC/90751-T2	E 1.99: DE87012984	MN -102	12:40353
PTB-SE-				
15	NTIS PC E07; Available from NTIS as TIB/B87-09399		ND -70	12:40563
RADC/ETR-				
87-0004	*See* AD-A-180242/0/XAB			12:41375
RAE-Lib-Trans-				
2103	NTIS (US Sales Only), PC A03/MF A01; 1	DE87900910	MN -38	12:41617
2143	NTIS, PC A02; 3	DE87900911	MN -38	12:41618
RCM-				
01184	NTIS PC E07; Available from NTIS as TIB/B87-07806		ND -86	12:40490
01886	NTIS (US Sales Only), PC A02/MF A01	DE87751895	MN -86	12:40491
RDA-PH-				
83-11-0006M1-83G	*See* AD-A-179933/7/XAB			12:41863
REPT-				
6361/ 1985	*See* PB-87-194163/XAB			12:41911
6361/ 1985-S	*See* PB-87-194155/XAB			12:41910
RERF-TR-				
2-86	NTIS (US Sales Only), PC A02/MF A01	DE87702657	MN -48	12:42248
10-82	NTIS (US Sales Only), PC A02/MF A01	DE87702658	MN -48	12:42249
20-85	NTIS (US Sales Only), PC A02/MF A01	DE87702659	MN -48	12:42250
RFP-				
4004	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012302	STD -38	12:41602
4030	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013420	STD -4	12:40492
RHO-HS-ST-				
11	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012723	MN -47	12:40611
Rijnhuizen-				
86-166	NTIS (US Sales Only), PC A05/MF A01	DE87702857	MN -20	12:42749
86-169	NTIS (US Sales Only), PC A06/MF A01	DE87702858	MN -20	12:42750
RISO-M-				
2536	NTIS (US Sales Only), PC A03/MF A01	DE87752324	MN -20	12:42799
2563	NTIS (US Sales Only), PC A03/MF A01	DE87752325	MN -20	12:42751
SAAS-				
342	NTIS (US Sales Only), PC A04/MF A01	DE87780154	MN -11	12:41681
SAND-				
85-1263	*See* NUREG/CR-4905	DE87012179	MN -80	12:41068
85-2319-Rev.	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99: DE87012517	STD -62	12:40724
85-2320-Rev.	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99: DE87012516	STD -62	12:40725
85-7209	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99: DE87013120	MN -70	12:40564
86-0487C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87004519	MN -38	12:41603
86-0867C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87005882	MN -80	12:41071
86-1605C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87005874	MN -78	12:41072
86-1656C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87006125	MN -78	12:41073
86-1797	*See* NUREG/CR-4710	TI87013103	MN -78	12:41048
86-1813C	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE87011311	MN -38	12:40883
86-2084-Vol.6-Pt.1	*See* NUREG/CR-4550-Vol.6-Pt.1	TI87011843	MN -78	12:41046
86-2084-Vol.6-Pt.2	*See* NUREG/CR-4550-Vol.6-Pt.2	DE87011844	MN -78	12:41047
86-2219C	NTIS, PC A02; 3	DE87008507	MN -38	12:41324
86-2364C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87001730	MN -80	12:40908
86-2483	*See* NUREG/CR-4871	TI87012097	MN -78	12:40945
86-2508C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87007847	MN -80	12:41074
86-2630	NTIS, PC A19/MF A01; 1 (GPO Dep.)	E 1.99: DE87013197	STD -80	12:41075
86-2666C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012016	MN -25	12:41365
86-2752/ 1	*See* NUREG/CR-4805/1	TI87012056	MN -80	12:41052
86-2838C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012980	MN -78	12:41076
86-2923C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87004241	MN -38	12:41604
86-2924C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011196	MN -28	12:41664
87-0006C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010686	MN -38	12:41579
87-0018C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011310	MN -28	12:41697
87-0019C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011285	MN -20f	12:42800
87-0031C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87005061	MN -38	12:41605
87-0056C	NTIS, PC A02; 3	DE87010743	MN -28	12:41762
87-0063C	NTIS, PC A02; 3	DE87010476	MN -38	12:41651
87-0095C	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87005853	MN -38	12:41574
87-0110C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87011314	MN -28	12:41719
87-0147C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010495	MN -63	12:40700
87-0190C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011720	MN -21	12:42801
87-0239C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011318	MN -28	12:41763
87-0279C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011286	MN -37	12:41669
87-0372C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012730	MN -45	12:41870
87-0423C	NTIS, PC A02; 3	DE87011853	MN -21	12:42802
87-0495C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011312	MN -28	12:41764
87-0562	*See* NUREG/CR-4887	TI87012684	MN -80	12:41065
87-0613C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011726	MN -21	12:42803
87-0633	*See* NUREG/CR-4896	TI87012896	MN -80	12:41067
87-0637C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012975	MN -38	12:40884
87-0648C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012972	MN -25	12:41325

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87-0677C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87012734	MN -25	12:41326
87-0735	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012513	MN -80	12:40909
87-0774C	NTIS, PC A02; 3		DE87011063	MN -25	12:41327
87-0792	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013400	MN -60	12:40747
87-0817C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012718	MN -25	12:41328
87-0830C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012729	MN -25	12:41329
87-0850C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012371	MN -38	12:41580
87-0875C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011094	MN -38	12:41330
87-0886C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012978	MN -25	12:41331
87-0910C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013523	MN -25	12:41395
87-0911C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012973	MN -25	12:41396
87-0917C	NTIS, PC A02; 3		DE87012719	MN -25	12:41397
87-0973C	NTIS, PC A02; 3		DE87012405	MN -25	12:41849
87-1123C	NTIS, PC A02; 3		DE87011633	MN -63	12:40719
87-1174C	NTIS, PC A02; 3		DE87012733	MN -71	12:40496
87-1384	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013412	MN -13	12:42305
87-1511C	NTIS, PC A02; 3		DE87011316	MN -38	12:41606
87-1512C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011719	MN -21	12:42804
87-1523	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87012326	STD -13	12:42889
87-1541C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012396	MN -132	12:40461
87-1542C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012395	MN -132	12:40460
87-1543C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012398	MN -132	12:40462
87-1544C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012397	MN -132	12:40463
87-1573C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012104	MN -66a	12:40732
87-1584	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013411	MN -13	12:42306
87-1612C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012722	MN -132	12:40466
87-1648C	NTIS, PC A02; 3		DE87011634	MN -38	12:41607
87-1649C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011722	MN -38	12:41608
87-1652C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013065	MN -132	12:42307
87-1653C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012358	MN -25	12:41366
87-1657C	NTIS, PC A02; 3		DE87011864	MN -21	12:42805
87-1675C	Society Petroleum Engineers, 222 Palisade Creek Dr., Richardson, TX 75080		TI87012731	ND -132	12:40464
87-1698C	NTIS, PC A02; 3		DE87011306	MN -38	12:41670
87-1864C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012373	MN -71	12:40497
87-1871C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012979	MN -25	12:41332
87-1894C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013068	MN -25	12:41398
87-7012	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012499	MN -60	12:40748
87-7064	*See* NUREG/CR-4781		TI87011925	MN -78	12:41051
87-8221	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013410	MN -38	12:41333
87-8222	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012999	MN -38	12:41609
SCPRI-RM-					
8-1986	NTIS (US Sales Only), PC A04/MF A01		DE87752249	MN -11	12:41937
9-1986	NTIS (US Sales Only), PC A05/MF A01		DE87752250	MN -11	12:41938
SERI/PR-					
212-3140	NTIS, PC A10/MF A01; 1 (GPO Dep.)	E 1.99:	DE87001163	MN -63	12:40701
SERI/STR-					
211-3033	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE87001178	STD -63	12:40702
217-3163	NTIS, PC A14/MF A01; 1 (GPO Dep.)	E 1.99:	DE87001176	MN -60	12:40749
231-3158	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE87001193	MN -61	12:40703
231-3179	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99:	DE87001200	MN -61E	12:40704
231-3180	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012262	MN -61E	12:40687
231-3181	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012263	MN -61E	12:40705
231-3183	NTIS, PC A11; 3		DE87012266	MN -61	12:40688
231-3184	NTIS, PC A12/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012265	MN -61	12:40689
SERI/TP-					
231-3194	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87001199	MN -61	12:40690
SERI/TR-					
215-2921	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87001179	MN -63	12:40692
215-3038	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87001177	MN -62	12:40693
SFB-					
210/ E-19	NTIS PC E09; Available from NTIS as TIB/B87-09405			ND -12	12:41941
210/ T-29	NTIS (US Sales Only), PC A04; 3		DE87770223	MN -38	12:41652
SLAC-					
298	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012351	MN -34D	12:41829
SLAC/AP-					
55	*See* SLAC-PUB-4187	E 1.99:	DE87010541	MN -28	12:41699
SLAC-CN-					
357	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87010650	MN -28	12:41765
SLAC-PUB-					
3820	*See* DESY-85-019			ND -34D	12:42418
4028	NTIS MF A01; 2 (GPO Dep.)	E 1.99:	DE87008330	MN -28	12:41766
4093	NTIS, PC A02; 3		DE87010322	MN -28	12:41720
4103	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87008318	MN -28	12:41721
4150	NTIS, PC A02; 3		DE87010320	MN -34D	12:42476
4169	NTIS, PC A02; 3		DE87005577	MN -28	12:41722
4176	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87009891	MN -28	12:41698
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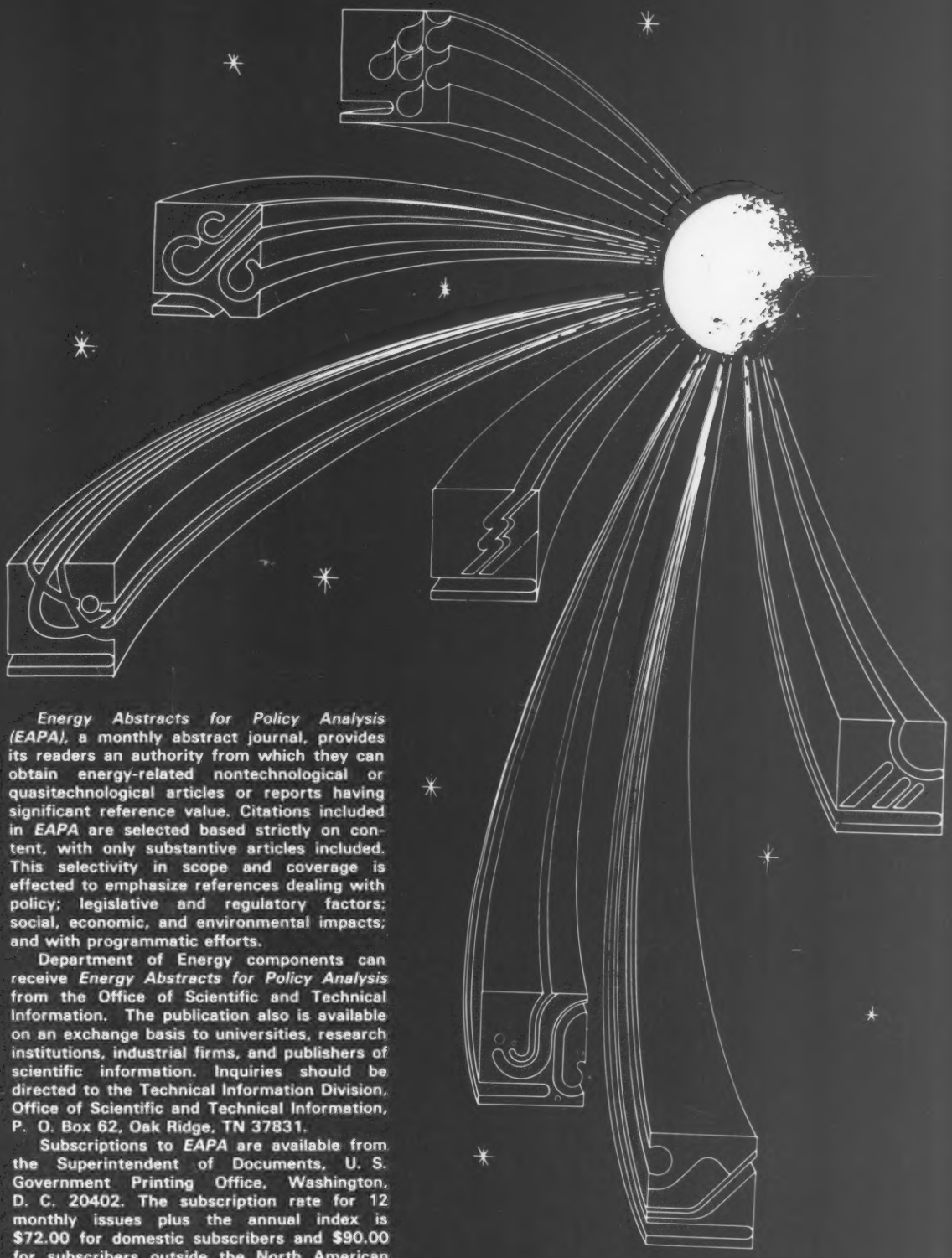

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